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NOVEMBER 2004
ISSN 1030-2662
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New

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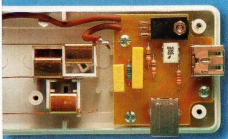

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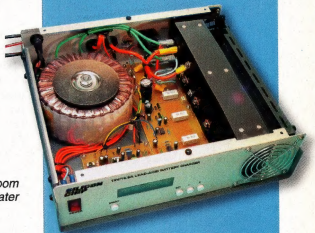

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SILICON CHIP
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SILICON CHIP is published 12 times a year by Silicon Chip Publications Pty Ltd. ACN 003 205 490. ABN 49 003 205 490 All material copyright ©. No part of this publication may be reproduced without the written consent of the publisher.

Printing: Hannanprint, Noble Park, Victoria.

Distribution: Network Distribution Company.

Subscription rates: $83.00 per year in Australia. For overseas rates, see the subscription page in this issue.

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ISSN 1030-2662

* Recommended and maximum price only.

PUBLISHER'S LETTER

Fixed line phones no longer a necessity

This month's feature story on "Unwired" internet access must worry anyone who has Telstra shares. Why? Because Telstra's customers no longer need a fixed line telephone service to obtain internet access. Up till now, if you wanted internet access, whether dial-up via a 56K modem or an ADSL broadband service, you had to have a fixed line telephone service. The exceptions would be if you had cable TV, in which case you could have a cable modem for internet or you might have used a satellite internet service. For the vast majority of people though, a fixed line telephone was a necessity.

Of course, if you don't need internet access and you already have a mobile phone, you have not needed a fixed line telephone service for some time. In fact, tens of thousands of people living in rented accommodation throughout Australia have long ago opted not to bother with a fixed line service. In doing so, they avoid installation charges which are hard to justify, since they normally only require a few minutes work by a technician at the local exchange. They also avoid monthly rental charges, high STD phone charges and so on.

For a person who makes very few phone calls, a prepaid mobile is definitely the way go. There are no rental charges, you only pay for the calls you make and incoming calls are free. Why bother with a fixed line telephone?

This is a world-wide trend, with the number of mobile phones rapidly exceeding the number of fixed line installations. In fact, many developing countries look to be leap-frogging the large infrastructure cost of fixed lines and just adopting mobile phone services instead.

In Australia, one could foresee a situation where most private individuals do not have fixed line phones – they would be confined to businesses and organisations. And then you have to factor in the concept of "Voice over IP" as described in last month's issue – for virtually any telephone calls. Large businesses are already migrating to VOIP for long distance calls and small business and private individuals will largely follow in the future. So even if they keep their fixed line telephone systems, they will be using VOIP and ADSL to cut their long-distance phone costs.

All of which does not augur well for Telstra. It has an enormous investment in its fixed line network in which it has a monopoly. But it doesn't have a monopoly in mobile phones where it is being buffeted by intense competition by some very aggressive players. So unless there is some new development which encourages customers to take up more services involving fixed line telephones, one can only see Telstra's fixed line revenues being severely eroded in the future. Sooner or later, and probably sooner, the investment pundits will realise this and the shares will go down accordingly.

This is yet another example of the inexorable march of technology. At one time, steam engines and horseless carriages had a very big market but they fizzled to nothing.

What can Telstra do? In the short term, it might like to buy Unwired Australia!

Leo Simpson

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PC User magazine August 2004

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MAILBAG

Video formats: why bother?

Jim Rowe is a braver man than I, in attempting to explain the reasons behind all those different video input configurations (August 2004), to even reasonably technically "fluent" electronics enthusiasts. I've given up trying to explain how and why you use the "16 x 9 scan" facility on TV sets with standard 4:3 tubes, in conjunction with the "16 x 9 output" facility on DVD players and digital set-top boxes!

And nobody seems to have any idea what I'm talking about when I try to demonstrate the differences between Composite, Component and Y-C video. Even I have trouble telling the difference sometimes!

There are a couple of small errors in his explanation of the use of luminance filtering in TV receivers. He states: "The problem here (in early TV sets) was that the low-pass filter ... had to have a cutoff frequency no higher than about 3.2MHz..." In fact, I have never encountered a luminance low-pass filter used in any colour TV receiver, nor is one necessary. With a proper "sync-coherent" colour subcarrier (ie, for PAL, one that is locked to precisely 283.75 times the line frequency plus half the field frequency), the visibility of the colour subcarrier on the screen is quite small.

In most cases, a simple 4.43MHz tuned notch filter is all that is required, simply removing some of the dot pattern from large areas of colour. Although this leaves the chroma sidebands untouched, you really only notice these on colour bar signals and similar electronically generated patterns.

The reality is, a well-designed standard PAL TV receiver will quite happily display luminance frequencies right out to 5MHz. The notch filter produces a small dropout at the colour subcarrier frequency but this is normally quite unnoticeable. This applies equally to the latest AV monsters, as to sets nearly 30 years old. (And yes, a surprising number of those old warriors are still going strong!) It is true that in recent years some el-cheapo TV sets have had some truly atrociously designed video output amplifiers, giving some pretty ordinary pictures, but this trend has now reversed with the proliferation of single-chip CRT drivers in even the cheapest models.

Low-pass filters have to be used with VCRs on the other hand, because the colour recording and playback process involves some extremely rigorous processing to enable the recovered chroma signal to be displayed on an unmodified TV set. If any of the original chroma signals managed to get recorded along with the luminance, you would wind up with a mixture of processed and unprocessed chroma, which would produce unsightly patterning on the colour image.

When VCRs were first introduced, it's true there was simply no practical means of doing this, other than using simple low-pass filtering. Even low-end broadcast formats such as High Band U-Matic suffered from this limitation. In virtually all cases, the luminance bandwidth is flat to about 2.5MHz and then drops to zero by 3MHz. Using the "80 lines per megahertz" rule of thumb, 2.5MHz equates to about 200 lines.

Although VCR playback signals have lost the subcarrier/sync coherency, the savagely reduced replay chroma bandwidth (typically ±300kHz) means that the TV set's notch filter can effectively filter this out, so it all works happily enough.

S-VHS ("Super VHS") and the concept of Y-C signals actually dates back to a 1979 proposal by JVC for a "turnkey" portable video theatrette system that would allow current-release movies to be shown in remote districts. This proposal sank without a trace and S-VHS was then reinvented as a "Vi-Fi" consumer format that never really went anywhere and was finally massaged into a reasonably successful professional and low-end broadcast format!

Because there is never any time when the luminance and chroma signals are mixed together during the playback process, it's perfectly OK for the luminance signal to have residues of the original colour subcarrier in it, which means that you can record and play back a virtually full 5MHz luminance bandwidth from off-air signals. (Of course you get even better results if the luminance is recorded directly inside the camera without ever "seeing" the chroma signal, which was the basis of S-VHS camcorders).

When DVD players came along, some manufacturers started to take advantage of the "S-Video" (Y-C) inputs available on some high-end TV receivers. Technically this was a mere detail: the analog luminance and chroma signals are generated separately in the MPEG decoder chips; all they had to do was divert some of these signals to the Y-C connector as well as combining them to produce a composite video output.

Y-C inputs are capable of quite good results; the problem is that they were only really designed to handle the 300kHz chrominance bandwidth of VHS signals. Although a DVD player could easily provide chroma signals with a wider bandwidth, certain peculiarities of the NTSC system limit any such improvement to only 500kHz (at least without major changes to the decoder circuitry).

Component video inputs on the other hand will deliver the full theoretical 1.5MHz chrominance bandwidth of NTSC signals, and in the present climate of international set design, this is the real reason TV set (and chip) manufacturers have gone for this system, even though S-Video is considerably simpler and cheaper to implement, on both ends. Otherwise S-Video would have been all there ever was!

Also, there seems to be a bit of confusion about the "Zone Plate" test signals shown in the article on the Video Enhancer and Y-C Separator. In theory, there should be no difference between the Y-C and Component input images. The reason we see a difference has more to do with the economics of DVD player design than the signal systems themselves!

This is understandable if you appreciate what actually goes on in the MPEG decoder/PAL encoder chips. In an old-fashioned (20th century) analog chroma encoder, the colour difference signals are fed to a pair of analog balanced modulators to generate the two suppressed-carrier AM signals. These are then combined with the luminance signal to give composite video.

In a modern DVD player, the entire modulated colour subcarrier is synthesised directly, by some very fancy software. This may not sound all that awesome, until you realize that the PAL 4.43361875MHz (and NTSC 3.579545MHz) colour subcarrier frequencies have no direct numerical relationship to the 27MHz master clock frequency most commonly used!

How do they do it? Well, consider an ordinary 4.43MHz unmodulated sinewave being fed to an 8-bit analog-to-digital converter, clocked at 27MHz. What you would get is a 27MHz stream of bytes which if then decoded by a DAC would reproduce the original carrier. There would be no immediately recognisable pattern to the numeric values of the string of bytes though, because the 27MHz clock would be continually sampling at different points on the waveform. However, there is a definite mathematical relationship involved and a fast enough computer can reproduce this pattern with a suitable mathematical algorithm.

From there it is a relatively simple matter to digitally multiply the samples with the values of R-Y and B-Y coming from the MPEG decoder, add the colour burst and voila: a complete modulated PAL subcarrier, direct from the DAC!

While this works very well, they have to cut a few corners, and so very few (if any) DVD players produce a true broadcast-quality sync-coherent colour subcarrier. Unfortunately this means that their wide luminance bandwidth is more prone to generating "cross-colour" artefacts. However, they can cheat somewhat; it is possible to identify and filter out just those luminance components which are most likely to cause cross-colour and that is what most manufacturers do.

I can assure you, if that zone plate was generated by pointing a TV camera at an actual printed chart, the colour artefacts would be much worse!

The reason why the Y-C and Component input displays look different is that in virtually all cases the luminance fed to the "Y-C" output is merely the "doctored" (pre-filtered) "Composite" luminance sans chroma! Apparently, generating a separate unfiltered "Y" signal for the "Y-C" output is simply too hard. I suspect the reason they don't simply use the Y from the YUV output is that most DVD players also allow you the option of RGB output from the same sockets and the potential for user stuff-ups is simply too large!

Keith Walters,
via email.

Caution on CFL driver power to TV

With regard to the CFL Driver in the September 2004 issue, if it is to be used to power a TV, first understand that the power switch on the TV is designed for use on AC where any tendency to contact arcing is quenched during the zero crossings. These switches arc notoriously when switching more than about 100V DC, even on a 2-pole switch.

Some TVs use a small power transformer to power the remote control receiver and CPU. This type of receiver MUST NOT be used on DC. It would seem to be a sensible idea to increase the value of the 6.8kΩ resistor to about 7.3kΩ by putting a 470Ω resistor in series with the original component. This should reduce the maximum voltage from the converter to around 335V while the unit is supplying standby power only or if the 12V line rises to say 14.5V as it could do while the battery is being charged in a vehicle.

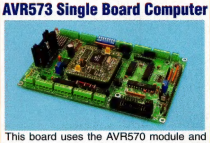
The reason for doing this is because most switch-mode power supplies work at about this value when operating from a nominal 240VAC mains

Atmel's AVR, from JED in Australia

JED has designed a range of single board computers and modules as a way of using the AVR without SMT board design

The **AVR570** module (above) is a way of using an ATmega128 CPU on a user base board without having to lay out the intricate, surface-mounted surrounds of the CPU, and then having to manufacture your board on an SMT robot line. Instead you simply layout a square for four 0.1" spaced socket strips and plug in our pre-tested module. The module has the crystal, resetter, AVR-ISP programming header (and an optional JTAG ICE pad), as well as programming signal switching. For a little extra, we load a DS1305 RTC, crystal and Li battery underneath, which uses SPI and port G.
See JED's www site for a datasheet.

AVR573 Single Board Computer



This board uses the AVR570 module and adds 20 An./Dig. inputs, 12 FET outs, LCD/Kbd, 2xRS232, 1xRS485, 1-Wire, power reg. etc. **See www.jedmicro.com.au/avr.htm**

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supply; higher voltages can cause premature power supply failure.

The degausser can be converted to operate from DC by charging a 150nF 500V capacitor from the 335V supply through a 330Ω resistor and discharging it through the degaussing coil manually with a robust pushbutton switch. The resistor can be left connected permanently. When the coil is shunted across the capacitor, the circuit will oscillate in a decaying fashion for a short period and in so doing the flux reversals will demagnetise the CRT.

The values are those I have used in the past with great success on professional portable monitors converted for battery operation. I have no idea if the values will work for the set mentioned in your article, however I see no reason why one could not experiment.

Note if a new TV is modified or even if the back is removed, one is liable to void the warranty. Also fitting a manual degausser with a pushbutton switch and then using the set on the 240VAC mains would render the safety certification for operation null and void so BEWARE.

Victor G Barker, VK2BTV,
via email.

Slander on CFLs unjustified

Your editorial that CFLs aren't economic, in the August 2004 issue, deserves a response. Until early this year I was on the body corporate of a large multi-story block of home units with 11 stair-wells that relied on artificial lighting.

The cleaner, who was responsible for changing light globes, came to me asking whether it would be a good idea to fit CFLs instead of incandescent globes. We tried it. He had previously been having to replace all the bulbs at an average of every six weeks. None of the CFLs had failed at the point at which equal cost was reached; ie, purchase price plus cost of power used for both was equal.

Only one CFL had failed within 48 weeks of being fitted, indicating that they met and exceeded the 8000-hour life their manufacturers claimed. In the end, it worked out that by using CFLs the body corporate was saving $600 per year just on the basis of globe costs and power, plus the cleaner's time savings.

I have used CFLs virtually since they came on the market and have had only one obvious premature failure. You really ought to be asking why you had the problems you did rather then slandering a good product.

Secondly, I must comment on your answer in "Ask Silicon Chip" to D. K., of Innisfail, who asked whether the Smart Mixture Display would work with a diesel engine.

If you were trying to be funny you should be more obvious, otherwise readers might conclude you give answers when you have no idea what you are talking about. Yes, the device will work with a diesel engine if it has an oxygen sensor but of course they don't, for reasons that are obvious to anyone who knows the basic principles that diesel engines run on. Detecting a lean mixture on a diesel would be pointless. They run lean by design. That's how they work.

Gordon Drennan,
Burton, SA.

Comment: sorry Gordon, but the answer concerning the diesel motor was fair dinkum and oxygen sensors can be fitted. Properly adjusted, diesels are supposed to run lean. Many don't.

Voltage warnings supported

I fully support your September 2004 editorial regarding the voltage warnings added to the projects in SILICON CHIP. Having some 45 plus years experience in electronics, I have seen (and been guilty of myself) too many accidents ending in smoke and tears. It is not only the beginner but the experienced technician and engineer that have the accidents that can put life and limb at risk.

I spent the early part of this year working in an electrical safety testing lab which, excuse the pun, brought me down to earth with a thud! Me, with all the years of experience, had the basics brought home to me in no uncertain terms.

Most of my time at the lab was spent testing mains voltage CFLs where the voltages could be in excess of 2500kV peak. Some voltage waveform measurements were carried out with respect to mains earth using an isolation transformer on the CRO and when measurements between output terminals were required, two isolation transformers were used, one on the CRO and one for the CFL. All this with a high-voltage probe to boot!

As you correctly stated in your Publisher's Letter, the main concern is the accidental transposition of neutral for active, which could render the earthy side of the CRO BNC connector live, with disastrous results.

So big and bold warnings please. If I skipped them before, after my six months in the testing lab, I will read them now.

Michael Abrams,
Capalaba, Qld.

Novices will make mistakes

The letter by Otto S. Hoolhorst concerning unnecessary voltage warnings, in the September 2004 issue, has me a bit steamed up. To me, he appears to have no regard for safety, possibly his own but obviously not for novices.

The old saying that "there are two things in life that are guaranteed, death and taxes" should have a third one added: "Novices will make mistakes". Lots of times. That's how we all learn. Most of us are lucky and no real harm is done.

I have 30 odd years in the electronics game, both military and civilian and even now I screw up sometimes. I screw up through complacency, a novice because of lack of experience.

We are only talking about a cautionary note but they are critical. A novice must be made doubly aware that incorrect actions can lead to disaster, especially with higher voltages. It's no big deal if you let the smoke out of some component, it's easily replaceable. But if you fry yourself in the process, maybe Otto is invulnerable but I'm sure not!

Yes, that project may not really be one suitable for a novice but no doubt they will attempt to build it, if it fits a need. Therefore it's best to err on the side of caution and safety.

The thing Leo may have been too polite to mention in his "Publishers Letter

is the legal aspect. Would Otto like to be in Leo's shoes if he has to explain to a prosecuting attorney why there was no warning that the project was potentially dangerous? Would Otto like to pay the fine/serve the time if someone died because they were not warned of potential hazards. I think not! Yet these days, a Publisher can be held accountable if an article they approved for printing is found to be a contributing factor in someone's injury/death.

Sorry Otto, those cautionary notes are there for a good reason. If they bother you that much, then too bad.

Ralph Teichel,
via email.

Separating SMPS transformer core halves

I read Keith Farmer's letter on the subject of separating SMPS transformer core halves with much interest (Mailbag, July 2004). I have rebuilt several computer power supplies and as Mr Farmer found, not all transformers come apart after soaking in paint stripper. I found that after the paint stripper treatment, dunking the transformer in boiling water released the glue holding the core halves together.

I would be reluctant to put an SMPS transformer core in a microwave oven in case the microwave energy caused high enough flux densities in the ferrite to produce an irreversible change in the magnetic characteristics. However, if Mr Farmer's treatment worked and the power supply subsequently operated without a problem, well and good.

Keith Gooley,
Edinburgh, SA.

Off switch is the best energy saver

Your recent articles on energy conservation and compact fluorescent lighting are timely and welcome. With regard to the former, I found during an energy audit that standby loads were using 1.5kWh per day. As such, I have been promoting the "off switch" as the cheapest energy saver available for some years now. Additional benefits include lower fire risk in the home and longer appliance life.

I have always been a little suspicious of the actual saving achieved by using compact fluorescent lights. Apart from the high cost and short lifespan issues, I believe they may not be as efficient as the label indicates. At a demonstration I attended at the Central Queensland University in Rockhampton, it was shown that the power consumption of a 15W CFL was actually 35-40VA in some cases.

I concur with your view on using fluorescent tube lights where possible. I find that low wattage incandescent globes, 25W & 40W, used in suitable locations for short periods are far more economical in the long term. Your advice to return CFL lights that fail prematurely is the only way we can expect product improvement.

Perhaps LED lighting will be a suitable replacement in the future.

Brian Bartlett,
Rockhampton, Qld.

CFL build quality is the key

I have to agree that many CFLs die early. I have even had them fry the instant they were turned on for the first time but as one of the letters in your latest issue also mentioned, certain brands are much better than others.

I have not had a Philips unit fail before around 6000 hours and have generally been very happy with them. The ones I have owned have certainly saved me a lot of money over the years. Another good brand is Osram, although they seem to be making their lamps in two places now; the cheap version comes from China while the better version still comes from Europe. You can buy the cheap ones in a pack of two for $5.99 in Coles supermarkets at the moment. And they are a nice warm white. I'm not sure how long they will run – will know that in a year or two I expect!

Back when the Osram lamps were called Wotan (I believe you can still get them under that brand), they were made in Germany and were just about unkillable. I know of two people here who have Wotan lamps dating back over 10 years that are still running (one home has several lamps that age and they are all working fine). How many hours these lamps have on them is anyone's guess, but it would be well over 10,000.

Anyway, I pulled apart one of my Wotan lamps after I got tired of waiting it to die after three years. It had much better rated components than any Asian made unit I have seen. For instance, 550V-rated transistors compared to 400V in the cheap lamps, and a 450V filter cap compared to 350V to 400V (there is not much margin on a 350V capacitor on a 250VAC supply!). At the time I pulled it apart it had already paid for itself, despite costing $30 at the time, but had I not killed it during the disassembly then it would have saved me a lot more.

So the problem is one of specification more than anything but build quality also comes into it. I had one lamp that was dead when bought, so I opened it up and found two of the tube leads touching each other. Separating them fixed it, and it is still going strong two years later.

So my advice is to buy the better quality units, because like most things, you get what you pay for.

Lance Turner,
Templestowe Lower, Vic. **SC**

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Want to go broadband anywhere . . . without waiting for ADSL or Cable connection?

Look Mum: No Wires!

Australians are amongst the world's largest users of the Internet. These days, if you have a computer, the chances are you have an Internet connection. And chances are also that it is dial-up, sharing the phone line with your existing voice phone service.

With the price of broadband ever falling, huge numbers of people have taken the plunge and signed up for one of the countless offerings available from an almost equally countless number of suppliers.

If you have ADSL broadband, well done. As we have found, it's not always as easy as the suppliers make it out to be.

If you could get over the hurdle of ADSL availability (eg, signing up for anything on the Telstra network meant living within just a couple of kilometres of the telephone exchange) you then had to wait for Telstra to let you know that first of all your line

By Ross Tester

was capable of handling ADSL (and apparently there are many that aren't, mainly due to cost-cutting installations in earlier, less-digitally-enlightened times). Then, some time (possibly weeks) later, you were informed that you had been connected to ADSL and you could plug in your broadband modem, sign up with an ISP and away you'd go. Hopefully.

Many consumers have been caught out with "bargain" broadband connections, finding that the usage limits (and in some cases both upload and

downloads count) are unrealistically low. While 300 or 400MB sounds a lot for a dial-up user, it doesn't take long to gobble that up – and then some.

Most people find that when they connect the always-on broadband, usage increases dramatically (why look up a phone book when you can find the info on the net?) and the usage limits are very quickly exceeded. And that's when some of the broadband ISPs really start earning bulk income: many ISPs charge downright exorbitant rates once you exceed your monthly limit.

But that part of broadband is really another story (solutions for which we hope to look at in more detail in a future issue).

Cable broadband has of course been an alternative – if (a) you could get it (and there are still vast areas which have not been "cabled") and (b) if you could afford it. Cable broadband has, at least until recently, been significantly more expensive than ADSL.

An aside: a mate of mine is an Optus cable broadband customer because ADSL isn't available at his place. He pays about seventy dollars a month for the privilege. Not long ago, Optus magnanimously told him they were upping his limit from the current plan's three gigabytes a month to ten. He very seldom uses any more than one gigabyte. Would they lower the monthly rate and keep him at three? Last time I saw him he was still whistling Dixie.

OK, so what if you could bypass the whole ADSL/cable rigmarole and have a broadband connection literally within minutes? One that is at least competitive with Telstra/Optus offerings? And perhaps more importantly, one that doesn't charge you extra for your excess usage?

Enter Unwired

If you live in Sydney, you could hardly have missed the ads for Unwired on commercial radio (OK, maybe you listen to the ABC . . .). Unwired is a one of the large number of service providers offering broadband Internet connection.

But Unwired is different. As its name suggests, Unwired doesn't rely on Telstra (or Optus cable, or any other copper) to connect you. It is totally wireless – all done via a network of 3.4GHz radio towers spread throughout Sydney, which (at the moment) cover about 90% of the population.

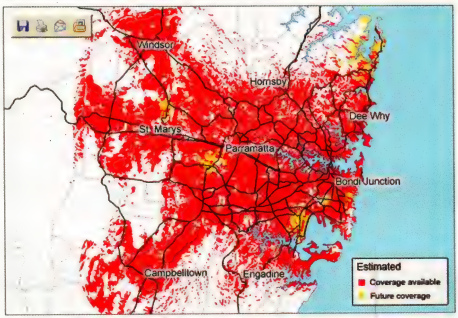
The Unwired system: in front is the Unwired "rabbit" modem, plugging into the ethernet connection on the laptop (USB versions are also available). It really is as simple as plugging in and turning on . . . providing you have wireless access.

Availability

The map of Sydney below shows estimated Unwired coverage in red, and future coverage in yellow.

To check if you can experience Unwired Wireless Broadband in your street, visit current coverage.

If it is not available in your street yet, you can register your interest now for future coverage, and we will be in contact as soon as coverage extends to your area.



Unwired's coverage of the Sydney area is pretty good, considering the topography. They cannot say how long the yellow bits will take to come on line.

Run, rabbit, run: the back end of the Unwired modem shows just two sockets, one for power and one for (in this case) PC Ethernet connection.

Right now there are 69 of these towers; shortly that will extend to 73 and cover closer to 95%.

Note that said population, not area. There is a big difference!

Of course, due to Sydney's topography there will always be some pockets not reached but according to Unwired, these will be relatively few and far between. It's not the same coverage as mobile phones but it's not too dissimilar.

And while it is only available in Sydney right now, Unwired has targeted Brisbane, Melbourne, Adelaide, Perth and other key regions in Australia for service expansion. They aren't saying when but we'd be surprised if it's not sooner rather than later, because Unwired has a very heavy investment in the spectrum space needed to provide the service. How much investment? A cool $100 million+ is the figure being talked about.

So how does it work?

We've published several articles in SILICON CHIP about WiFi – digital wireless "networking" using (mainly) the 802.11b or 802.11g standards on 2.4GHz. Well, Unwired is not WiFi – although it is similar in some respects. For a start, it is significantly higher in frequency – around 3.4GHz.

Wifi, via a wireless network card inside your desktop PC, or a PC card or USB stick attached to your laptop, links to a local access point, itself "hard wired" to ADSL or cable in the normal way.

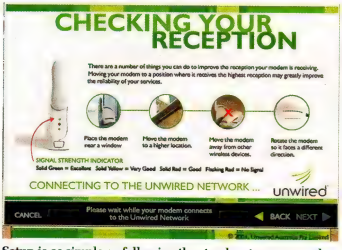
Hence your connection to the 'net is based on standard copper wire technology until the last little "hop" via wireless. It also depends on that access point being and staying connected. Often (usually?) you have to pay for the privilege of using it and in some cases, it can be as expensive as using an internet café!

Unwired users have an entirely different type of connection – it uses a special wireless modem (often called a "rabbit" – and if you look at the photos, you'll see why!) to connect to one of their strategically-placed towers. It doesn't even have to be line-of-sight but it does have to be within range. They talk about a range of around 10km (which, at 3.4GHz, is not too shabby!).

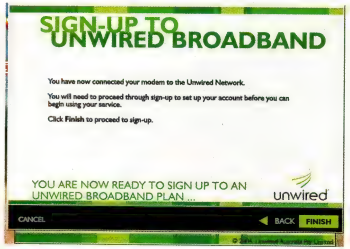
The front end of the Unwired Modem showing the fold-up rabbit ear antenna plus the three indicator LEDs and power switch.

Unwired is based on a proprietary (and patented) system called "Multi-Carrier Beamforming Technology" (MCSB) from Navini Networks in the USA. It's also known as Nomadic Wireless Broadband Access, bringing wireless not just to an antenna or dish on the roof (as some other systems do) but right to the user's computer (or at least to the modem close by).

To connect to Unwired, you simply plug in the modem. That's either via a USB port or an Ethernet port,



Setup is as simple as following the step-by-step screens that appear when you run the setup CD which comes with the modem.



Naturally, you have to sign up to one of the Unwired plans before you can start surfing – but you can do this on line as part of the setup procedure. It's delightfully simple to do.

depending on the type of modem purchased.

The modem cost, by the way, is about $189, either on-line (direct from Unwired or via several agents) or retail from technology chain Harvey Norman.

If you're in a reception area, after a few seconds one of three coloured LEDs on the unit glows steady. You then sign up for a plan using your credit card, and you're on line.

Total elapsed time? You'd hardly have enough time to get the egg out of the fridge, let alone boil it . . .

Speed

Once connection is established (and we'll look at that in a moment), there appears to be little difference between apparent speeds loading and browsing sites I was familiar with using Unwired or using ADSL/cable. Given the fact that I was using a computer which would have little if any cached sites, I was pleasantly surprised by the speed and smoothness of the wireless system.

The three plans on offer run at 256/64Kbps, 512/128Kbps and 1024/256Kbps (download/upload speeds – like ADSL, Unwired is not synchronous).

Unwired does not run at a constant speed; it varies according to usage of the system at any given time in much the same way as cable broadband varies: more users, lower speed. For the two weeks or so I played with Unwired, I cannot say speed ever dropped to "too low" levels, although I have read many reports of people complaining of sluggishness at certain times of the day (especially early evening).

Also, I experienced none of the dropouts which have been reported in other media, although given the minimal signal strength in my area I would not have been surprised to find dropouts a problem.

There have also been reports of massive variations in signal strength on different floors of the same building – one report, surprisingly, said that on the fourth floor there was no signal while on the ground floor there was.

Not wireless?

Believe it or not, there has been comment in the popular press (and on newsgroups) that Unwired really isn't a wireless system because you have to connect the modem to your PC and also to a power outlet.

Sheesh!! What do they want? Taking the second point first, they're wrong, because the Unwired modem contains an internal rechargeable battery which will give you up to an hour's connection away from a power source – as our lead photo (and front cover) shows!

The other objection really doesn't warrant a comment, except that it points up a very good reason for not having non-technical journalists

And here's the proof: the SILICON CHIP website on screen less than three minutes from the time we turned the computer on. Speeds on the service we had were commensurate with our mid-range ADSL service at the SILICON CHIP office.

What about iBurst?

While we have been concentrating on Unwired, other wireless contenders have recently launched on the Australian market, or are in the process of doing so even as this issue goes to press.

The most prominent of these is iBurst, backed by the large ISP Ozemail. Their Personal Broadband service was launched in late September (although it would appear that Ozemail have renamed theirs Metrowide Wireless).

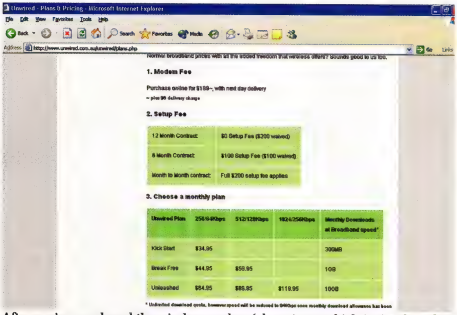
Unfortunately, we couldn't look at iBurst as we have Unwired, because as yet it doesn't have much coverage of Sydney's Northern Beaches at all!

iBurst uses a different system (Arraycom's IntelliCell technology) to achieve a somewhat similar result. Like Unwired, it will offer broadband coverage over a wide area of Sydney (though not yet as wide as Unwired) but is already launching into interstate markets. Most of the northern Gold Coast is already on line (sorry, wrong choice of words – not on line, on wireless!) and iBurst was promising to have Brisbane, Melbourne and Canberra up and running within a matter of weeks.

In fact, iBurst will offer two versions of its wireless service – one is a mobile system in the true sense of the word, capable of giving a seamless connection to a notebook computer in a car travelling at up to 50km/h. Tests we have seen haven't been quite so good as the marketing hype suggests but still relatively good, nevertheless. Prices are relatively steep at $99/month for a 1MB per second/1GB limit service and $199 per month for a 1MB per second unlimited service. Still, if mobility is important to you, you're probably prepared to pay the price.

The second service is similar to the ADSL/cable alternative offered by Unwired – ie, portable, not mobile. Prices are more reasonable (though slightly higher than Unwired), starting at $49.95 a month for a 256KB service and $99 for a 1GB service.

Ordering is via the web (www.ozemail.com.au) with modem delivery within 24 hours. Ozemail promise to have your account activated by the time you receive your modem.



After you've purchased the wireless modem (about $189, which *is* significantly more than an ADSL/cable modem), the plans are not dissimilar to the plans offered by wired broadband ISPs. The minimum plan is $34.95 per month.

talking about matters technical in the non-technical press! And now I have that off my chest . . .

What affects Wireless strength?

The location of the antenna can often make the difference between no signal at all and wall-to-wall signal... or anywhere in between. Because in the case of Unwired the antenna is an integral part of the modem, that means placing the modem in the most advantageous position.

Filing cabinets, steel-reinforced concrete walls, aluminium-backed wall or ceiling insulation . . . even someone walking between your modem and the wireless tower (wherever that might be) can cause degradation or even total loss of signal. That's why you might need to experiment somewhat for best signal level.

It's quite common to read reports of rock-solid signal on one side of a building and low or no signal on the other. Low signal levels mean that data speeds are reduced or sometimes data disappears and the link drops out.

The USB or Ethernet (crossover) cables supplied with the modem are only a couple of metres in length. But you might need to place the modem (say) on the other side of the room for best signal strength.

The Ethernet modem would be the best option here because you can buy significantly longer cables (many metres long) which will have little apparent effect (if any at all) on your system speed.

Naturally, your system will need an Ethernet card for this to be practical – either on-board, as most late-model desktops and laptops are, or an add-in Ethernet card (fortunately now VERY cheap!).

The USB option, on the other hand, does limit you to a fairly short distance. You can buy USB extension cables but your maximum is just a couple of metres more. Otherwise you would have to start looking at amplifiers – our advice is to stick with the Ethernet version.

Is Wireless affected by rain?

Mmm – good question. There's a lot of discussion about this point, with some saying it is (a little) and some saying it isn't at all.

Because wireless signal strength DOES vary significantly due to any number of factors, we believe that rain might often be the innocent victim – eg, signal strength's down a bit today. Yep, it's raining. Therefore it must be the rain causing it.

(Corollary: the bank robber was described as having blue eyes and blonde hair. There's a blue-eyed blonde. He must be a bank robber . . .).

The truth is (at least according to many satellite websites that we've looked at) that rain normally only starts affecting radio signal to any significant degree when the wavelength approaches the raindrop size. 3.4GHz signals have a wavelength of about 0.09 metres or 9cm, a tad larger than even Noah-sized rain.

For all intents and purposes, you can use the figure of 10GHz as the minimum affected frequency (for the same reason, Ku-band [11-13GHz] satellite signals can be affected by rain while C-band [4-5GHz] are relatively immune).

How well does it work?

Here's where we came across the first stumbling block. Unwired's marketing people suggested we try the system "both at home and in the office" because they were selling Unwired as suitable for both home use and small office use.

OK, first thing I did was had a look at the Unwired coverage map on their website. Like many ADSL/cable websites you can type in your street name and suburb and you'll get a map showing availability (www.unwired.com.au/availability/current.php).

I did – type my street name in, that is. Aaaaaagh!!!! Not in the service area. Strike one. (Of course I tried – just one street away I managed excellent reception. One lousy street!).

I have seen several comments about being able to use Unwired well outside their "official" service area. But not in my case.

So I thought I'd try the SILICON CHIP office and typed in the address.

Aaaaagh!!!! Strike two. In fact, the whole of the Mona Vale area, one of the major retail, business and industrial centres of the Northern Beaches, is not covered. That was a surprise.

When I raised this anomaly with the people from Unwired, they informed me that there was a site available for a tower which would solve the problem for both areas.

But thus far they had been stymied by some misguided tree-hugging souls who maintained that those electromagnetic thingies would make them glow in the dark or something. (So they used their mobile phones to call all their friends to the protest . . .)

No strike three!

What to do? Fortunately, my "home away from home", Narrabeen Beach Surf Lifesaving Club, was in an area with coverage (it is in a pink area on the Unwired website map).

So – down to the club, plugged the modem into the Ethernet socket on the club's PC, turned it on and . . . no signal.

You can tell whether you have signal by the three LEDs on the front of the unit. Green means a very strong signal, orange a strong signal and red a good signal. Flashing red means no signal.

As advised in the setup, I moved the modem slightly closer to a window and, joy of joys, the LED stopped flashing – "good" signal. Elsewhere in, and outside, the club (away from the foil-covered roof insulation), the signal was green – excellent.

The setup via the supplied CD was, thankfully, a doddle and I was on the net literally three minutes from when I turned the PC on – including entering the password and user names which Unwired had thoughtfully provided.

Mr or Mrs Average Citizen would get their password and user names when they first log on and purchase their plan.

Unwired in use

Quite simply, I found using Unwired broadband very similar in performance to the two other broadband services I regularly use: ADSL here at SILICON CHIP and cable at home.

Regrettably, I wasn't in a position to do any actual speed tests (I was about to but the trial period ran out!) but purely by observation, I would have to say I was pretty happy with the way Unwired broadband behaved.

That feeling was further backed up when one of my colleagues here at SILICON CHIP took the Unwired modem home for a few days. He's in the north-western suburbs of Sydney and reported an instant "green" signal (excellent level) when he plugged in Unwired and no problems whatsoever with surfing the 'net.

Unlike me, he is close enough to the exchange to theoretically get ADSL but suffers from the Telstra "pair gain" bogey so it's back to the "incompatible infrastructure" excuse. Though Foxtel cable is available in his street, given his success with Unwired, he's pretty firmly convinced which way he is going to go.

Is Unwired safe?

A few moments ago, I made somewhat flippant comment about electromagnetic radiation. But is that a concern with the Unwired system?

Given the fact that Unwired is "up there" on 3.4GHz (much higher than mobile phones, WiFi or even microwave ovens!) AND the fact that you have a device emitting e-m radiation very close to where you are working, perhaps it *is* something to be wary of.

Where I was being sarcastic was in objections to electromagnetic radiation from Unwired towers: sure, transmitted energy levels will be higher but the inverse square law tells me that the radiation at ground level would be diminished to virtual background levels.

Having said that, I would be wary about having an Unwired modem in close proximity to where I'm sleeping (and let's face it – a lot of kids would have their PC, ergo their Unwired modem, on a desk next to their bed). In fact, I'd want to keep the distance between it and me as far as practical.

Even Unwired themselves have a warning with the modem that it should not be used within 20cm of a person. It's probably more of a "protect your butt" clause than anything else but it's something to keep in mind.

Do you *really* need a phone line any more?

Many of Sydney's (and, obviously, Australia's) young, mobile population live in rented accommodation which may or may not include a phone line. Even if it does, there's the cost and hassle of having the phone connected, rent to pay, not to mention (in the majority of cases) the inconvenience of a different phone number when you move.

That's why so many people have given away the fixed phone line, instead relying on their mobiles to stay in touch. If and when they move, their phone number goes with them. And there's no re-connection fee, line rental, bond, whatever.

Now even that is set to change as we enter the Wireless Broadband era.

Last month we featured Voice Over IP, (VoIP), explaining how it could dramatically lower your phone bills – especially if you were on broadband.

Unwired is broadband. You are already paying for the connection (without time constraints) so why not use Unwired in conjunction with a Netphone or headset on your PC to make ALL your "phone" calls. Hey, this could even *replace* mobile phones!

Admittedly, calls are costed by time but if you're not one to sit on the phone for hours, it is a completely viable option. As we pointed out last month, quick local calls can even cost less than what you currently pay. Long distance is where VoIP really starts to shine.

So there it is: a new service which we believe will revolutionize not just the way we surf the net but the way we use our telecommunications systems and infrastructure.

For more information, visit **www.unwired.com.au** SC

COMING NEXT MONTH

Satellite TV reception – the downside of Unwired

Those who remember the first (VHF) television bandplan implemented in Australia will remember that it was a total debacle, with channels 3, 4 and 5 bang-smack in the middle of the international FM broadcast station allocation.

"It's OK," they said at the time. "Australia doesn't have any FM radio stations. . ." Not then, we didn't.

It's taken the best part of fifty years to unscramble those particular eggs.

Believe it or not, the Government has done it again, with wireless broadband.

Our satellite TV writer, Garry Cratt, will tell how the powers-that-be have managed to auction off chunks of the international C-band Satellite TV spectrum for data communications.

The net result is that people who have gone to considerable expense to set up their own C-band receiving systems (dishes, LNBs, receivers and so on) are now complaining long and loud about wireless broadband.

The spread of frequencies is again right on top of many of their favourite satellite signals and in this case, Goliath wipes out David every time.

"Too bad" say the authorities. "You're not supposed to be watching overseas satellite television programs anyway. . ."

In some cases, the problems can be cured, or at least eased, as Garry explains next month.

DICK SMITH ELECTRONICS

Benchmark

Nov 2004

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$66.94

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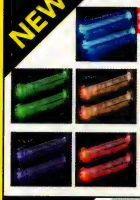

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$24.98

NEW

THERMALTAKE 420W ATX PSU
420W total power, dual fans, supports AMD K7 and Intel P4 series, incl. IEC power cord. Z 8550
Only available at Powerhouse stores

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THERMALTAKE Extreme Spirit BIOS Cooler
Keeps chipset from overheating, incl. 3-speed fan controller switch (fits into a free PCI slot) and 3-pin connector. Z 8322
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PC Tri "Laser" Beam Kit 12V DC
Flexiglow 3 super bright LEDs in a plastic chrome housing, incl. Molex type power connector.
Z 8075 Blue Z 8077 Green
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Uses a lightweight 55W soldering pencil fitted with a highly flexible burn-resistant silicon-rubber sheathed cord. Supplied with plated and pre-tinned 1.6mm tip.
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$98

HOT BUY

NEW

PRO-IRODA PRO-70 70W Soldering Iron
Cordless, simple and safe to operate under any conditions, incl. soldering tip and protective cap. **T 1104**

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NEW

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Operates up to 3hrs on refill, precise temperature control, portable, cordless and lightweight. Incl. 2 glue sticks. **T 1419**
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Add wall switches all over your home, without the need for extra wiring. Requires a 3V lithium battery. Compatible with the full range of X-10 home automation products. **M 4017**

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NEW

X-10 Hawkeye Motion Sensor
Tiny wireless motion sensor that can be attached to the wall with screws or self-adhesive strips. Activated by lighting sequences when detecting movement; a built-in photocell ensures that it operates only when it is dark. **M 4016**

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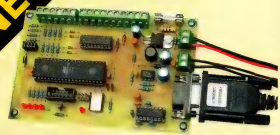
NEW



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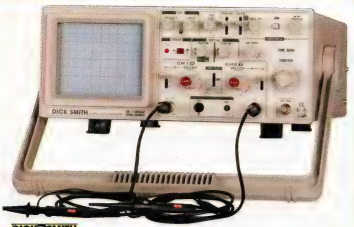

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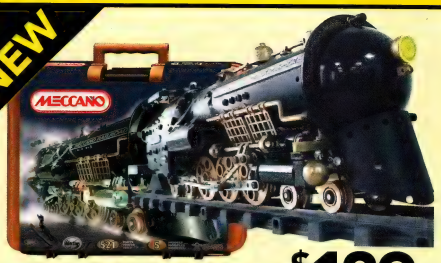

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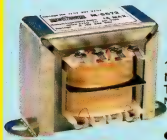

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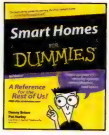

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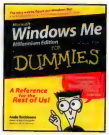

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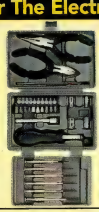

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- Suits cables up to 6.5mm diameter
- Series resistance at 25MHz = 120Ω Min
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- Frequency range: 10MHz to 300MHz

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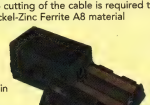
R 5120



43.4x23x22mm
- Suits cables up to 9mm diameter
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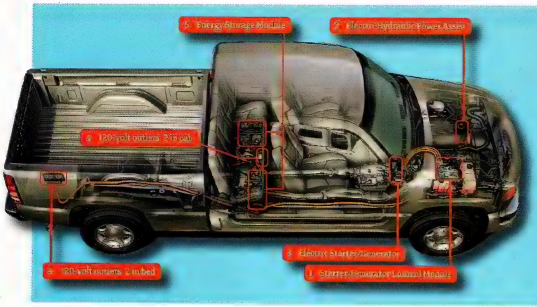


The GM Silverado/Sierra hybrid is a full-sized pick-up truck. Unlike the Toyota Crown, it doesn't use an electric motor as a traction motor or for mechanically powering accessories when the engine is not running. Instead, it uses a conventional 5.3-litre V8 and 4-speed automatic transmission with a 14kW, 3-phase induction AC starter/generator sandwiched between the transmission and the engine. Energy storage is by a 36V lead-acid battery. [GM]

The New Era in Car Electrical Systems

The first cars using the new 42V standard are now being released. So why the move from 12V and what are the implications for the design of higher voltage car electrical systems?

By JULIAN EDGAR

BACK IN OUR JULY 2000 issue, we briefly looked at the way in which vehicle electrical systems are changing. The use of high-output alternators and 42V electrical systems were being mooted as technical solutions to the ever-increasing electrical power demands in cars. What's happened since? Well, in a few words – a lot!

Toyota in Japan currently sells a car with a 42V electrical system, while GM in the US is this year releasing a 42V pickup truck – and some organisations are already using pre-delivery vehicles. New technical standards are being developed to cover everything from 42V battery terminal and fuse design to the colour-coding of 42V wiring. Automotive component suppliers have developed 42V alternators, starter motors, circuit breakers and other components. Some are predicting that by 2010 as many as half of all vehicles will use 42V electrical systems. In 20 years, the forecasts suggest that all cars will use this voltage.

Even more interesting is the relationship developing between "mild" petrol/electric hybrids and 42V electrical systems. Throw in the increasing availability of mains power in cars (yes, that's right – in the USA you can now have a factory-fitted mains power socket in your car!) and the whole area of car electrical systems is undergoing a change of a magnitude never seen before.

Power-hungry cars

The trends in automotive technology can be summarised as:

- Better fuel economy
- Reduced exhaust emissions
- Improved safety
- Better comfort and convenienc

Each of these has implications for the load placed on car electrical systems. For example, improvements in fuel economy can be gained by applying systems such as automatic engine stop/start capabilities, electrically-assisted acceleration from a standstill, electric engine cooling pumps and fans, and electric power steering and air-conditioning.

Also being thoroughly investigated is the electromechanical operation of engine valves. While it could bring about significant increases in engine power and efficiency, this approach looks likely to be electrically power hungry, with estimates of up to 2.4kW peak loads on a six-cylinder engine.

Table 1

Daimler Chrysler	Fiat
Renault/Nissan	BMW
General Motors	Toyota
Peugeot/Citroen	VW/Audi
Ford	Honda

Car manufacturers in North America, Europe and Japan currently developing 42V cars

Reductions in emissions can come from electrically heated catalytic converters (some cars already have these), while dynamic safety can be improved by the use of active electric power steering, active suspension and high-powered electric de-icing of glass. Finally, increasing comfort and convenience can lead to the use of electrically heated and cooled seats, electrically heated steering wheels, high-end sound systems, in-car computers, navigation systems and the provision of mains-power sockets.

Even without including electrical propulsion, components supplier Delphi expects the growth in electrical loads in cars to be 5% per year over the next 20 years. If electric propulsion is included, that estimate rises to 8% per year. Fig.1 shows the past and estimated future increases in car power demands.

The consumer acceptance of the latest model Toyota Prius – this year Toyota expects to sell 50,000 in the USA alone – has given car manufacturers the confidence to start thinking seriously about incorporating electric-assist into otherwise conventional designs. These so-called "mild hybrids" use electric assistance only in certain conditions. For example, in a mild hybrid, the petrol engine is turned off whenever the vehicle is stationary. The electric motor then helps the car accelerate as the petrol engine re-starts. The gains in fuel economy are not as great as in high-voltage full hybrids but the manufacturing and development costs are much lower.

This acceptance of mild hybrids makes the rate of growth in electrical power demand likely to be close to Delphi's 8% per year estimate.

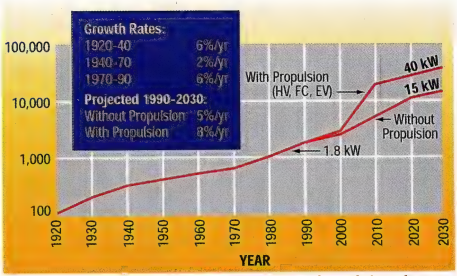


Fig.1: past and estimated future increases in car power demands (note the logarithmic vertical axis). The massive increase in electrical power loads is seeing a move to 42V systems. [Delphi]

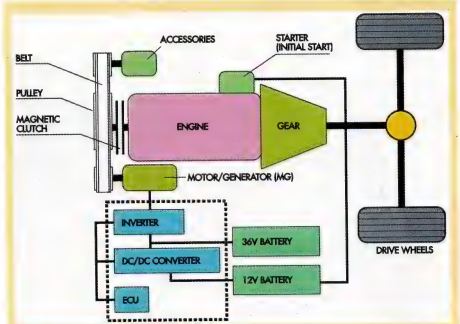


Fig.2: the mild hybrid Toyota Crown is the first car in the world to feature the new 42V standard. It uses a 3kW 3-phase AC synchronous motor/generator in conjunction with a 147kW petrol engine. The transmission is a conventional 5-speed automatic. The motor/generator, which is larger than a conventional starter motor but not as large as the traction motor used in a full hybrid, charges a 20Ah 36V battery via a water-cooled inverter. [Toyota]

42V systems

Prior to 1955, vehicles used 6V electrical systems. However, recognition in the US that higher ignition energy would be required for the high compression V8s then being introduced prompted the adoption of a higher voltage system. In addition, the introduction of higher power headlights, radios and higher-powered starter motors were all showing the limitations of the 6V system. 12V systems – using 13.8V regulation – were then introduced, with most manufacturers achieving the transition within two years.

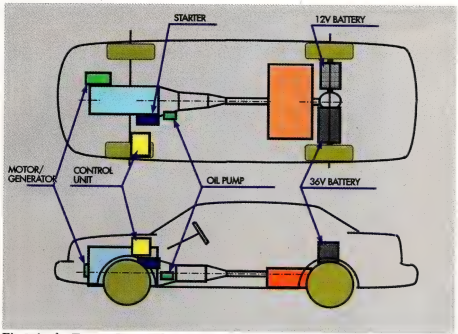


Fig.3: in the Toyota Crown, the 12V battery is charged via a DC/DC converter and the 36V battery from the generator inverter. Both batteries are mounted over the rear axle of the car in the forward section of the boot. [Toyota]

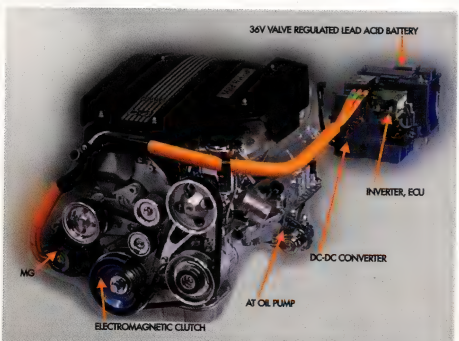


Fig.4: the use of an electromagnetic clutch allows the Toyota's motor/generator (MG) to drive the accessory belt even when the engine is off. By engaging the clutch, the motor generator can start the engine and even help propel the car. [Toyota]

The increasing power demand of current cars has now caused a similar situation to develop – a higher voltage is needed. However, the situation isn't quite the same – there are far more devices of vastly greater sophistication working on the current 12V standard than there were working on 6V in 1955.

The new standard is termed a 42V system. That is, battery voltage is 36V with the bus regulated at 42V. Basing the standard on the 42V running-car voltage, rather than the 36V lead-acid battery voltage, was done to cater for future developments that might displace lead-acid batteries and traditional charging systems.

One benefit of increasing the voltage to 42V is a reduction in wiring gauges. A current mid-size car has a wiring loom that weighs 35kg or more and contains 2km of wire, 1000 cut leads and 300 connectors. With the potential for loads of many kilowatts (the catalytic converter heating in the BMW 750iL requires a short-term power of 17kW!), the current flow required at 13.8V becomes very high indeed. As a result, conductor sizes are large, adding cost and weight. Increasing the voltage reduces the current flow and so smaller conductors can be used.

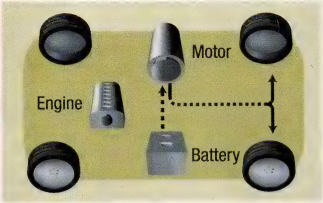
In addition to reducing conductor size, adopting a 42V standard allows the development of powerful combined starter/generators, more compact and powerful electric motors, and other actuators that are smaller, have a lower mass and improved performance. Table 3 shows some of the benefits of adopting 42V systems.

Another advantage of the higher voltage is in the field of semiconductors. The cost of semiconductor switches, which are expected to be used very widely in cars, depends on the current and voltage ratings of the device. The current-handling capability is related to the semiconductor's area, while the voltage rating is tied to the device's thickness and doping profile. A reduction in required current capability results in a smaller chip area, decreasing costs.

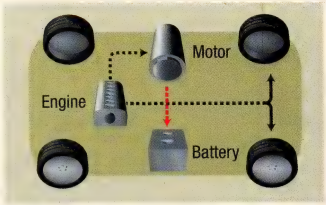
For example, an electric power-steering controller may need to handle a power of 600W. At 14V with an assumed electronic efficiency of 85%, the switch is required to handle 50A. However, at 42V the required current handling drops to less than 17A, reducing the cost of the power-dependent components by 60%.

But why just 42V? If reductions in conductor and electric motor size are the criteria, why not use 500V, say, as does the current model Toyota Prius? There was widespread consensus that the new voltage standard should be sufficiently low to ensure the personal safety of those that come in contact with it. During the development of the new standard, the Society of Automotive Engineers performed an in-depth study of the research that had been carried out on human tolerance to electrical shocks. The society concluded that protection against direct contact

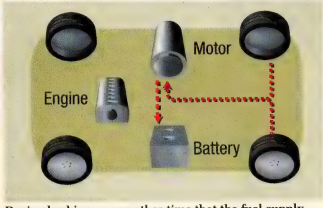
Toyota Crown Running Modes



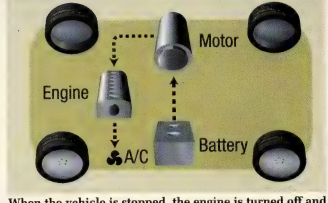
The petrol engine switches off whenever the car is stationary. On restart, the electric motor/generator drives the car and starts the engine.



In normal driving the petrol engine propels the vehicle. If battery charge is low, the electric motor/generator is used to charge the battery.



During braking or any other time that the fuel supply to the engine is cut, the electric motor/generator regeneratively brakes and so charges the battery.



When the vehicle is stopped, the engine is turned off and the electric motor/generator powers the accessories such as the air-conditioning compressor. [Toyota]

was not required if the voltage did not exceed 65V DC, including ripple. Subsequently, the German standards body VDE reduced this to 60V. The specification of 42V systems suggests that a maximum bus voltage of 55V is permitted during dynamic over-voltage conditions.

Table 1 shows car manufacturers in North America, Europe and Japan currently developing 42V cars, while Table 2 lists the automotive component suppliers currently developing 42V components.

The first 42V cars

The first two cars featuring 42V technology are mild hybrids that run dual 12/42V electrical systems. The Toyota Crown mild hybrid has been produced in small numbers in Japan since 2001 and initial deliveries of the General Motors Silverado/Sierra hybrid twins are occurring now, with full sales to begin later this year.

(1). The Toyota Crown Mild Hybrid: the Crown uses what Toyota dubs a "Toyota Hybrid System – Mild", or THS-M. Fig.2 shows its layout. A belt-driven motor/generator comprising a 3kW 3-phase AC synchronous motor is used in conjunction with a 147kW 3-litre in-line 6-cylinder petrol engine. The transmission is a conventional 5-speed automatic. The motor/generator, which is larger than a conventional starter motor but not as large as the traction motor used in a full hybrid, charges a 20Ah 36V battery via a water-cooled inverter. The motor/generator is used to:

- restart the stopped engine (initial starting is by a conventional 12V starter motor).
- help drive the vehicle when moving away from a standstill.
- generate all electrical power.
- provide regenerative braking on deceleration.
- drive engine auxiliaries when the engine is stopped.

The 12V battery is charged via a DC/DC converter. Both batteries are mounted over the rear axle of the car in the forward section of the boot (Fig.3). The motor/generator, which is located where a conventional belt-driven alternator normally would be, is able to drive the accessories with the petrol engine stopped because in this mode a magnetic clutch is used to decouple the accessory belt drive system from the engine.

Just some of the parts developed for the mild hybrid Toyota Crown (clockwise from top left): the engine; 36V battery; inverter & electronic control unit; and electric motor/generator.

Fig.4 shows an overview of the engine bay. In stop/start urban conditions, fuel consumption is improved by about 15%.

(2). GM Silverado/Sierra hybrid the GM Silverado/Sierra hybrid is a full-sized pick-up truck. Unlike the Toyota Crown, the GM mild hybrid does not use the electric motor as a traction motor or for mechanically powering accessories when the engine is not running. It uses a conventional 5.3-litre V8 and 4-speed automatic transmission – the design criteria required that an existing GM engine be used and that the transmission had only minor modifications for its new hybrid vehicle role. Overall driveline length also needed to remain the same as non-hybrid versions.

In order that these criteria could be met, the starter/generator (GM call it simply the 'electric machine' - EM) is inserted between the engine and the transmission, with the torque converter being reduced in diameter to create the space. To overcome problems of excessive heat resulting from a smaller torque converter, the transmission control strategy is revised to allow earlier-lock-up of the torque converter clutch. The EM is then used to reduce poor driveability resulting from this early lock-up.

The EM is a 14kW, 3-phase induction motor. The rotor is bolted to the engine's crankshaft and surrounds the torque converter. This approach allows the crankshaft's bearings to support the rotor.

The stator is located around the rotor and is supported by an assembly positioned by existing dowels projecting from the rear of the engine block. It is clamped between the transmission and the engine. The stator is water-cooled via a thermostat-controlled feed from the engine coolant system.

Changes made to the transmission included the use of a unique bell-housing and flex-plate and an alteration to the hydraulic valve body that allows the transmission to drive the engine (and so the EM) on over-run in second and third gears. In addition, a small electric pump is used to provide hydraulic pressure within the transmission until the transmission pump is rotating quickly enough to provide normal working pressures.

The GM mild hybrid uses these strategies to reduce fuel consumption:

- deceleration fuel cut-off much more frequently used, with the EM smoothing the resulting torque fluctuations.
- automatic engine stop during stationary and very low speed vehicle operations.
- lower speed torque converter lock-up clutch engagement.
- regenerative braking.

A 42V electro-hydraulic power steering pump replaces the traditional engine-driven unit, while air conditioning requirements with the engine stopped are met by "careful management of refrigerant capacity already in the system prior to the stop". The traditional starter motor is deleted.

42V challenges

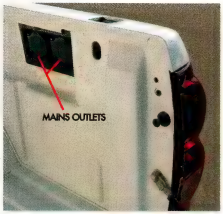
The change in such a universal and long-standing car standard as 12V has some major challenges – technical and financial. Taking the latter first, why should customers feel any urge to pay more for a car that has a 42V electrical system?

General Motors puts it like this: "A 42V system is only an enabler. It is not something that consumers will be willing to pay for directly – so it

Table 2

Bosch	Yazaki
Motoral SPS	Denso
Aisin	Valeo
Motoral AIEG	JCI (Johnson Controls)
Continental Teves	Visteon
Siemens VDO	Lear
Delco Remy America	Varta
Infineon	Magneti Marelli
Delphi	

Some of the automotive component suppliers currently developing 42V components. Delphi, for example, state that they can now provide a complete 42V generation, conversion, storage, distribution and usage system.



General Motors see the inclusion of 110VAC power sockets in their mild hybrid pick-up truck as a major selling point of hybrid technology. The circuits are protected by ground fault detection and up to 14kW is available.

General Motors delivered its first hybrid pick-up truck on May 3, 2004. The mild hybrid uses a combined electric motor/generator and boasts 10-12% improved fuel economy. The car is only the second to use the new 42V standard. [GM]

absolutely must deliver the capabilities and features that customers desire and value."

The company suggests examples of such customer-desirable features are mains-power outlets, new entertainment systems, electrically heated windscreens, fast heating and cooling systems and "by-wire" chassis and engine controls. They also suggest the thinner wiring looms and smaller components will provide space for more features likely to appeal to the consumer.

The fuel economy achieved by 42V combined starter/generator systems will also have immediate consumer appeal. It's for customer justification reasons that GM has highlighted the availability of mains power (there are four outlets!) in its promotion of the Silverado/Sierra hybrid.

12V/42V possibilities

What about cars where a 42V electrical system is introduced in conventional engine form? As with the two hybrid cars that we've looked at, it's very likely that cars will continue to have both 42V and 12V systems for some time to come. In fact, it is suggested that incandescent lighting will stay at 12V because of bulb durability issues associated with the automotive use of higher voltages.

Three 12V/42V architectures are likely to be used:

- **Single voltage generation and single voltage energy storage** – a 42V alternator charges a 36V battery which services 36V loads, with a DC/DC converter used to charge a 12V battery that services 12V loads;
- **Dual voltage generation and single voltage energy storage** – a dual 14V/42V alternator charges two separate systems, one 12V and the other 36V;
- **Dual voltage generation and dual voltage energy storage** – a dual 14V/42V alternator charges a dual 12/36V battery.

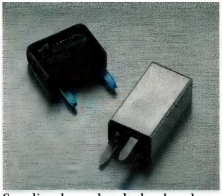
In all cases the inclusion of 42V car systems poses challenges in control-

The GM mild hybrid control system incorporates an inverter to generate 110VAC mains power (four mains power outlets are provided on the truck), a DC/DC converter to operate the 12V loads and an inverter that operates the starter/generator. [GM]

Table 3

Current Technology	Benefits of 42V Architecture
Electric power steering	More power, improved fuel economy
Electric brakes	Redundant power supplies
Power windows, power seats, power hatchback lifts	Reduced size and mass of motors; more efficient operation
Heated catalytic converter	Lower emissions; quicker light-off time
Heating, ventilation, air-conditioning blower motors and cooling fans	Greater efficiency; smaller/lighter units; flexible packaging
Mobile multimedia	More power available for video, mobile phones, navigation systems, audio amplifiers, fax machines
Water pumps	Improved efficiency; longer service life
Selected engine management system components (eg, exhaust gas recirculation valves, ignition systems, control actuators)	Reduced size and mass; increased performance
Fuel pumps	Reduced size and mass
Heated seats	Faster heating, more efficient operation; increased power

The benefits to current automotive electrical technology of adopting a 42V system. [Delphi]



Suppliers have already developed a complete range of 42V automotive components. Here are two 42V compatible bimetallic circuit breakers, available in 5 - 30 amp ratings. [First Technology]

ling arcing and corrosion, especially in the presence of contaminants like salt water. (An example? – consider a boat trailer's electrical system that can be under water quite frequently!)

Another "real-world" problem is the use of jumper leads. To prevent people with 42V cars attempting to jump-start 12V vehicles, 42V vehicles will have non-accessible batteries and use a dedicated jump-starting connection with a unique, fused connector. 42V jumper leads will be specific to the application and incorporate microprocessor control. One proposal sees the use of 42V jumper-leads occurring in the following manner:

- Connect terminations to each car or car and boost pack.
- Units activates (wakes up) and checks polarity – both LEDs flash.
- LED flashes red if either or both batteries are reversed.
- Low current circuit is activated and checks for conductivity.
- If all is OK then green LED flashes.
- Switch is pushed and internal relay is activated – green LED on.
- Relay is opened if either battery is disconnected – green LED flashes.
- If both batteries are below 36V or either battery is below 18V, relay will not activate – red LED on.

Fuses also need redesigning. Testing was carried out of normal 12V blade-type fuses on 42V and it was discovered that when subjected to overload, terminals could melt away (probably through arcing) and the plastic fuse housing was subjected to intense heat, resulting in carbonisation and melting. New 42V fuses use polyamide housings and feature a slightly different shape to 12V fuses, preventing 12V/42V fuse inter-changeability. Circuit breakers suitable for 42V operation are already available.

Wiring standards also need to be upgraded. The current proposal is that all 42V wiring is coloured amber. Because of the potential problems of arcing, all 42V terminal connections will need to be correctly seated and locked. More sealed connectors will be used.

Note that not all wiring will be reduced in conductor size – in many cases those wires that are 0.35mm^2 will remain that size even when working on 42V, as this is the minimum size for mechanical durability.

Conclusion

While it was initially thought that the first 42V cars would be luxury cars with very high electrical power loads, mild hybrids have beaten them to the punch. In addition, a report that Daimler Chrysler has put 42V system development on hold appears to be a temporary setback for that company. However, over the next few years a wide range of cars will appear with 12V/42V systems and as they become common, it won't be long before dedicated 42V cars appear. **SC**

Super-Capacitors For 42V Systems

Super-capacitors suitable for 42V automotive systems are being developed. These capacitors can be used to meet peak loads and then be recharged over a period from an existing battery or at a fast rate through regenerative braking.

A 10kJ, 42V super-capacitor has sufficient energy to operate the combined starter/generator of the 5.7-litre V8 GM Silverado/Sierra hybrid for two consecutive engine starts (the engine starts in 0.3–0.5 seconds). Compared with a lead-acid battery, a combined super-capacitor-battery prolongs battery service life with its ability to handle high recharge/discharge events typical of a mild hybrid car.

However, at this stage super-capacitor costs remain high when compared with traditional battery technology.

(NEW) CHARGER / DISCHARGER + 40 Ni-MH CELLS

New in original box with instructions. This unit was designed to charge and discharge Ni-CD & Ni-MH mobile phone batteries of 4.8V, 6.0V and 7.2V. Operates from 12-24V DC input. Features include processor control & multi stage charge indicator. Includes cigarette lighter lead, 12V / 1A DC plugpack (worth around $30) & instructions for modifications for higher voltages. All of this plus 10 packs of Toshiba 4 cell pack 1.2V @ 800mAh Ni-MH Batteries. Each cell measures 10mm x 50mm (same length as AA & same diameter as AAA batteries). Pack size: 12.5mm x 64mm x 48mm. **(ZA0100PK)** $20

JUST $20 FOR ALL OF THIS

NEW Toshiba BATTERY PACKS

4 X 4 800 mAh Ni-MH cell battery packs. These cells are as long as AA cell and as thick as a AAA cell. New in original packaging. **(2D0060)** 4 packs for $5

NEW SAFT BRAND 500mAh AA NICAD CELLS

These French made high quality cells come with solder tags attached. **(2D0061)** 5 for $2

110-240VAC 50/60Hz to 24V @ 1A POWER SUPPLIES

This small 94 X 63 X 28 fully enclosed housing has 1.8M output cable with a four pin DIN style plug and a STD common figure 8 mains input socket, mains lead not supplied. New in original packaging. **(PC24)** Only $4 each

NEW LARGE COLOUR LCD Hitachi LMG9200XUCC

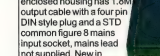
These high resolution colour LCDs are brand new laptop displays. There are not easy to connect to or to drive. A Internet search showed lots of info. **(LGM)** $15 each

NEW BRIGHT 5mW 635nm VISIBLE LASER MODULE

This module emits an orange/red beam which is more visible and brighter than the 650-670nm modules. Consists of a visible laser diode, diode housing, APC (automatic power control circuit) driver, and collimation lens all factory assembled in one small module. Requires ~4.5V to operate and consumes approx. 50mA. Overall dimensions of unit are 8mm dia. by 13mm.$11 **(LM1)**

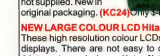
OXG1- cross generating optic $0.55

OLG1 - line generating optic $0.55



NEW 6VDC LUXEON LED DRIVER KIT

This kit is designed to drive 1-3W from 4-6V, usable down to 3V! Shown actual size $5.90. **(K216)**



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Cheap home automation with these new miniature UHF modules.Band width limited to 1.2kbs.

(TX434) $9

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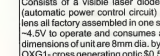
POWERFUL DC MOTORS / GENERATORS:

The 200W motors are the same as used in our scooters. They are very powerful for there size, 24V use, but produce lots of torque at 12V. They start rotating at only 0.5VDC. These motors make great generators . When driven at a low speed with a cordless drill they produced 6V open circuit, 5V @ 5A & 4V @ 8A; Very reasonable freight costs to most Australian capitals.

(NEW) 100W DC MOTOR:

100W output as used in our small scooter. 24VDC. Rated speed: 2300 RPM Rated current: 6.0A Measures: 67mm X 97mm (+ shaft) Shaft: 8mm "D" shaped end with cir-clip groove. Weight: Approx. 1.1kg $22 **(SC100)**



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WG1 NEW 200W WIND GENERATOR

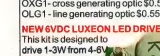
These are serious 3 phase 200W wind generators with blades spanning 2.2M. They are designed to start operating in low air speeds (around 11kph) while being robust enough to withstand strong gales. They are rated at 200W @ 25kph with a max. of 250W. Each generator is supplied with a 3 Phase rectifier and a Meter box. One of the meters measures the battery voltage, the other measures the charging current. These generators output 3 phase (sine) and our optional new charger kit will enable you to charge banks of batteries. For more information and instructions see our website.

We have suitable 5.5M mast at no extra cost, but would require an engineering certificate. A disclaimer form needs to be completed, signed, and mailed back to us before the order can be processed.

Please call/email for more information.

12V / 200W WIND GENERATOR: (WG1A) $699

24V / 200W WIND GENERATOR: (WG1B) $699



Tired of having to switch the power to your PC's peripherals on and off manually, as well as switching the PC itself? Here's a simple way to make life easier by having the PC control the power to its peripherals automatically via one of the USB cables. There's only a handful of components involved and they can be built right inside a low-cost multi-way power distribution board.

USB-UP

By JIM ROWE

A USB-controlled Power Switch

Most of the first generation of personal computers had an 'IEC'-type 240V outlet on the back of the box, which provided power switched by the PC's own power switch.

This allowed you to control the power to the computer's monitor, printer and other peripherals simply by plugging in a power distribution board to this outlet and plugging the peripheral power cords into the distribution board outlets.

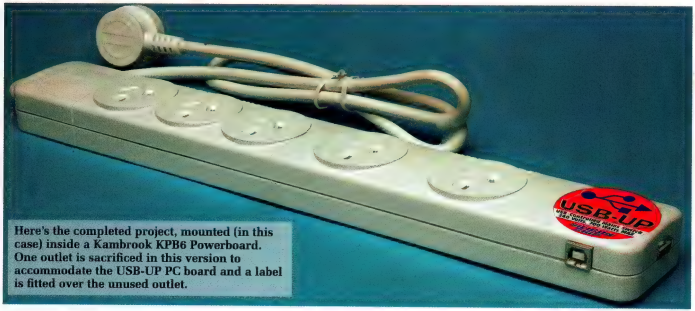
The power switch on the front or side of the PC then controlled everything, which was very neat and convenient.

Unfortunately this handy switched power outlet disappeared from later models, presumably because it became harder to implement when PC manufacturers changed over to software-controlled power supplies.

So, with most newer PCs, if you wanted to control everything with a single switch, you've been forced to use a power distribution board with its own master power switch.

There is a way to get true single-switch operation, though, if you're using a recent model PC with at least one USB port (and that means just about any PC made in the last few years or so).

This is to control the power fed to the peripherals using an electronic switch triggered by low-voltage DC from the PC itself, via its USB port. The electronic switch then turns the peripherals on when the PC is turned on, and turns them off when it's turned off.



Here's the completed project, mounted (in this case) inside a Kambrook KPB6 Powerboard. One outlet is sacrificed in this version to accommodate the USB-UP PC board and a label is fitted over the unused outlet.

PLEASE NOTE:
This project involves opening and modifying a mains powerboard. Do not attempt this project unless you are experienced in mains wiring and construction. Contact with the mains can cause severe injury or death. Never work on a power board with the plug in an outlet, let alone turned on.

ALSO: While the original powerboard is rated at 10A, 240V (2400W) the modifications made limit the total loading to around 700-750W, or 3A. This limit should be more than adequate for the intended application: switching computer peripherals.

Forgive the mess of cables: normally these would of course be behind or under the desk, out of sight. But then we wouldn't be able to show you the USB-UP powering the monitor, amplified speakers, external IDE/USB disk, printer, even a phone charger . . .

The electronic switch needs to be optically isolated, so there's no risk of 240VAC getting back into the low voltage circuitry of the computer via the USB port. But a high-voltage opto-coupler neatly solves that problem.

In this article we'll show you how to build a USB-controlled electronic power switch right inside a low-cost power distribution board, for maximum safety and convenience.

How it works

When a PC is powered up, +5V DC appears on pin 1 of each of its USB port sockets. We simply tap off a few milliamps from this convenient source of 5V DC, to trigger a 240V Triac via an optocoupler. The Triac therefore switches power to your peripherals whenever the PC is powered up.

The circuit is shown in Fig.1. A pair of standard USB sockets, CON1 and CON2, allow the circuit to be connected in series (ie, daisy-chained) with any normal USB peripheral cable. All of the USB connections go 'straight through', so the added circuitry is essentially transparent as far as USB communication is concerned.

The connections to the USB port are to pin 1, the +5V line, and pin 4, the ground (0V) line. Across the two we connect the input LED of OPTO1, an MOC3021 opto-isolated Triac driver, with a 220Ω resistor in series to limit the current to 15mA – just sufficient to ensure reliable triggering.

The optical isolation inside the MOC3021 is rated to withstand voltage 'spikes' of up to 7.5kV peak, which reduces the risk of flashover to a very low level.

The 470Ω and 390Ω resistors and the 47nF 'X2' rated capacitor ensure that when OPTO1 is triggered on it in turn switches on the BT137F Triac, at very close to the zero crossings of every 240V AC power half-cycle.

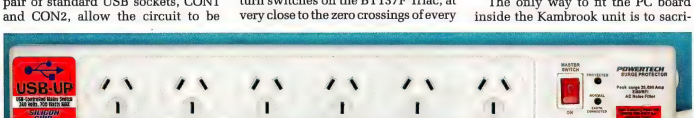
Finally, a series combination of a 10nF capacitor and a 39Ω resistor is connected directly across the Triac to form a 'snubber' circuit. This protects the Triac against spurious triggering caused by mains spikes or switching spikes produced by inductive loading of some of the peripheral device power supplies.

Construction

We have a designed a small PC board which fits into typical 6-way distribution boards like the Jaycar/Powertech MS4031 or the Kambrook KPB6.

The Jaycar Powerboard has the advantage of having room inside the case for mounting without "surgery" and also contains spike and noise suppression; however it is more expensive than the Kambrook Powerboard.

The only way to fit the PC board inside the Kambrook unit is to sacri-



The alternative power board from Jaycar, the Powertech MS4031. It is more expensive than the Kambrook but does not need any "surgery" to fit the USB-UP PC board inside (so you retain all six outlets) and also has very worthwhile surge/spike protection built in.

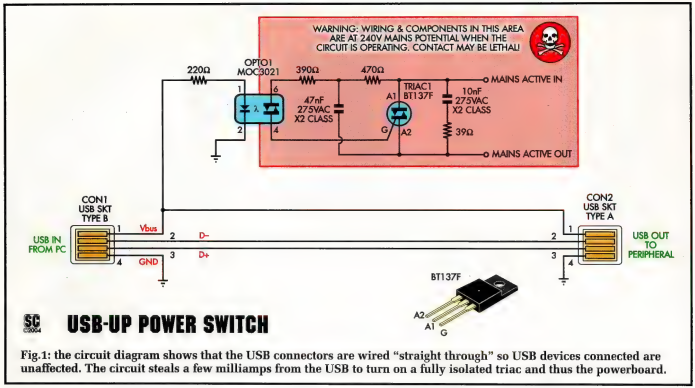


Fig.1: the circuit diagram shows that the USB connectors are wired "straight through" so USB devices connected are unaffected. The circuit steals a few milliamps from the USB to turn on a fully isolated triac and thus the powerboard.

fice one of the six outlets and mount the board in its place. We'll explain how shortly.

The PC board measures 48 x 43mm and is coded 10111041. The board has rounded cutouts in two adjacent corners, to allow them to be fitted between pillars inside typical distribution boards.

Fitting the components to the PC board shouldn't present any problems if you follow the overlay/wiring diagram carefully.

Just make sure you fit the two USB sockets in the correct positions, as they are different in terms of their pin layout. Take care with OPTO1 and TRIAC1, to fit them the correct way around. The Triac body is held down against the PC board using a 6mm M3 machine screw and nut.

Before mounting the PC board in a typical 6-way distribution board, you have to open up the board by removing the 'tamper proof' screws which fasten the upper and lower halves together. These screws can usually be removed fairly easily using a matching hex-shank bit from one of the multi-bit sets available from many electronics suppliers and bargain stores.

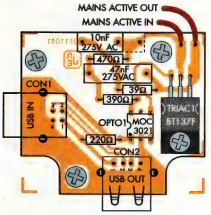
Or you can make your own "tamper proof screw" screwdriver by filing a small (2mm or so deep) notch in the centre of a spare flat-bladed screwdriver of suitable size.

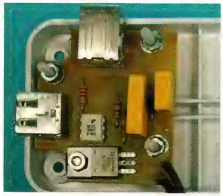
Once you have the board opened, there will be a different procedure, depending on whether you are installing the PC board into the Jaycar/Powertech MS4031 or the Kambrook KPB6. Let's talk about the Jaycar distribution board first.

Jaycar MS4031 Powerboard

You can see the general arrangement from the internal photos which were taken inside a Jaycar MS4031 board. There is just enough open area in the end of these units to fit the PC board assembly.

Making the connections is as follows: the short brown wire connecting the 'Active' bus bar of the six outlet sockets to the original RFI filter board (at the cord entry end of the case) is removed, and replaced with a 300mm length of similar brown 250VAC-rated wire running from the existing RFI filter board down to one of the mains





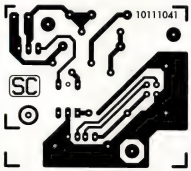


Fig 2 (left): the PC board overlay, with the PC board pattern itself shown at right. In the centre is the completed PC board for comparison.

Parts List – USB-UP

1 PC board, code 10111041, 48 x 43mm
1 6-way power distribution board (see text)
1 Type B USB socket, PC-mounting (CON1)
1 Type A USB socket, PC-mounting (CON2)
3 25mm x M3 Nylon machine screws (Kambrook) or 9mm 6G self-tappers (Jaycar)
1 6mm M3 metal screw
4 M3 nuts & lockwashers

Semiconductors

1 MOC3021 opto-isolated Triac driver
1 BT137F 600V/8A isolated-tab Triac

Capacitors

1 47nF 275V 'X2' rated metallised polypropylene
1 10nF 275V 'X2' rated metallised polypropylene

Resistors (0.25W 1%)

1 470Ω 1 390Ω
1 220Ω 1 39Ω

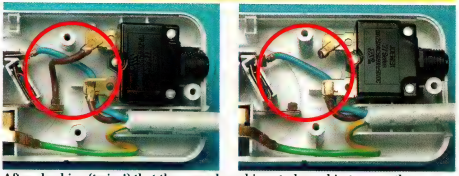
connections on the new USB switch board.

Then an additional 30mm length of the same wire is used to connect the second mains connection on the switch board to the adjacent 'other end' of the long brass strip forming the Active contacts of the outlet sockets.

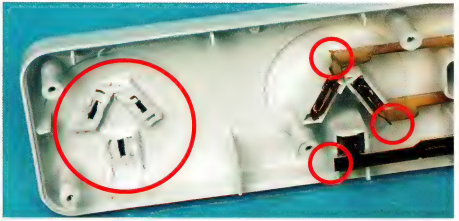
The board is mounted in the end of the case using three 9mm long 6G self-tapping screws, which mate with pillars already moulded into the inside of the upper part of the case.The only work required on this part of the case is to trim down a couple of these pillars to the same height as the shortest original one, so they form a stable support trio. This can be done quite easily using a sharp hobby knife.

STEP-BY-STEP: Modifying the Kambrook powerboard

The Jaycar powerboard is similar but note the differences as explained in the text!

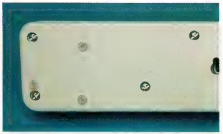


After checking (twice!) that the powerboard is not plugged in to an outlet, remove the back and identify the active (brown) wire between the overload switch and the active bus (left pic). Cut this wire at both ends and remove it.

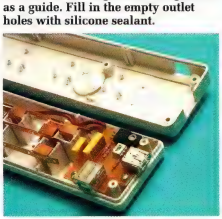


At the opposite end of the powerboard, cut the Active, Neutral and Earth bus bar straps immediately after the fifth outlet. Remove these, then cut away the plastic supports for the sixth outlet. Grind them down until they are nearly level with the case body.

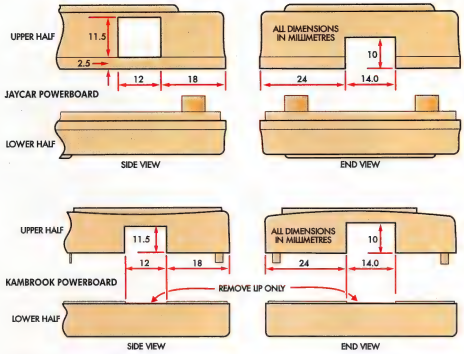
Cut away the appropriate slots for the USB sockets, using the drawing below as a guide. Fill in the empty outlet holes with silicone sealant.



Drill the three 3mm holes in the bottom of the case to accept the three Nylon mounting screws.



The completed project in the top of the Jaycar powerboard (left) and the bottom of the Kambrook powerboard (right). The Jaycar version is by far the easier to make.



These diagrams should assist you with the USB slot cutouts. At the top are the cutouts for the Jaycar powerboard with the Kambrook powerboard below.

The Triac body is held down against the PC board using a 6mm M3 machine screw and nut.

It will be necessary to make cutouts for the USB connectors in the lower half of the case. A slot is cut in the end of the case half to clear the Type A output socket, while a square hole is cut in the side for the Type B input socket.

I found it fairly easy to cut the slot using jeweller's files, but it was necessary to drill some holes in the side to 'start off' the rectangular hole. The idea is to work slowly and carefully, so you don't make either cutout any larger than is necessary to clear the two sockets.

That's about it. After fitting the USB switch board into the case and making the two connections, you can reassemble the case again using either the original 'tamper proof' screws or some ordinary self-tappers.

Kambrook 6-way powerboard

The procedure in the Kambrook power board is different because there is no space at the end as in the Jaycar example.

To make space, we cut the brass connecting strips between the fifth and sixth 3-pin sockets and discarded them, then removed all of the plastic contact supports for the 3-pin socket.

The easiest way to do this is to carefully break out small pieces with a pair of pliers, then smooth the whole lot with a rotary grinder.

To be sure, to be sure, we filled the now-vacant 3-pin socket holes with some silicone sealant to make sure nothing could be put into the holes.

The other main difference between the Kambrook and Jaycar boards is that we found it much easier to mount the PC board in the base of the Kambrook unit (rather than the top as was used in the Jaycar board).

The reason for this is that there is a continuous plastic barrier strip moulded into the base of the Kambrook unit which turned out to be 9mm high – the same height as the mounting spacers we used.

So there was no need to cut away any of this barrier – the PC board sits on top of it, held in place by the three Nylon screws, nuts and 9mm spacers.

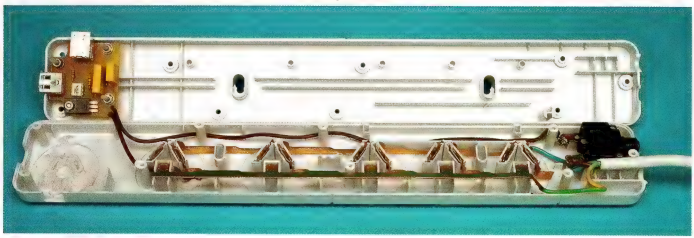
The Nylon screws need 3mm holes. After you've drilled the three holes and removed any burrs, push the Nylon screws through from the outside, fit metal spacers, then the PC board.

The same square cutouts need to be made to give access to the USB sockets; in the Kambrook power board matching cutouts are needed in the lip on the bottom section.

In some ways, the cutouts are easier on the Kambrook case top. We simply cut down the required amount using a hacksaw blade (see diagrams for distances), then bent the waste back and forth with a pair of pliers until it snapped off.

One piece snapped off nice and cleanly but Murphy's law ensured that the other needed cleaning up with a fine file.

Because the slots in the base are so



Here's the Kambrook powerboard, completed but not yet screwed back together.

block off the slots for the now unused 3-pin socket. The original 'tamper proof' case assembly screws can be re-used again if you wish, or replaced with normal 6G self-tapping screws.

Using your USB power board

Putting your USB power board to work is easy. All that you need to do is connect the USB 'upstream' socket (on the side) to one of the USB ports on your PC, using a standard USB connection cable.

The power leads of your peripheral devices then plug into the distribution board's outlets, so their power is controlled by it. Just bear in mind the 750W (3A) total loading.

Finally, the powerboard closed up again, immediately before we fitted the label over the now-unused sixth outlet. You can see the difference between the two types of USB socket in this photo. The label is shown below left, same size.

If you have USB leads from peripheral devices already plugged into all of the PC's USB ports, that's no problem. Simply remove one of them from a USB port socket, and plug the lead from the USB Power Switch into that socket.

The lead from the peripheral can now be plugged into the output or 'downstream' socket on the Power Switch, so it's reconnected to the same USB port.

And Bob's your uncle! Your peripherals will now be automatically turned on and off with the computer. **SC**

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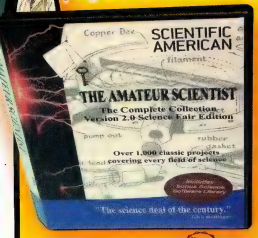

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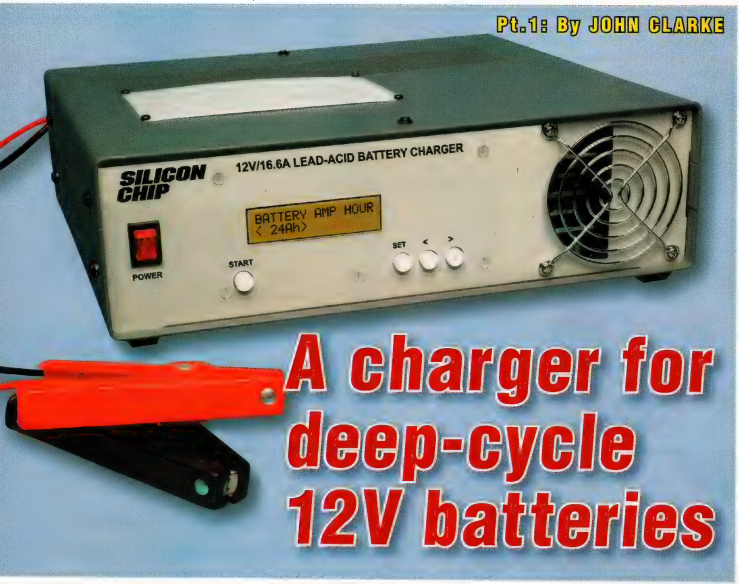
Pt.1: By JOHN CLARKE



If deep cycle batteries are not properly charged, they will never be able to deliver their full capacity and their life will be greatly reduced. You can't use a general-purpose 12V car battery charger. This 3-step charger is specially designed for deep cycle batteries and will charge at up to 16.6A.

DEEP CYCLE BATTERIES are expensive and are designed for a long life. If properly charged and looked after, they should last 10 years or more. Their chemistry is quite different from that of car batteries and if you use a charger intended for car batteries, you will definitely not get their maximum capacity.

Furthermore, if deep cycle batteries are consistently under-charged, they will have a short life. By comparison, car batteries are seldom charged above 70% of their capacity but they are designed for "shallow" discharge. If they are subjected to frequent deep discharge, they will have a very short life.

Deep cycle battery manufacturers specify that their batteries should be charged up to a fixed value called the "cyclic voltage". Once the battery is charged to this level, the voltage must be reduced to the "float" voltage and then it can be left permanently connected to the charger. Continuous charging at the cyclic voltage will damage the battery.

The cyclic voltage is usually different for each type of lead acid battery. For example, standard lead acid batteries should be charged to 14.2V and floated at 13.4V, while Gel-Cell (Sealed Lead Acid) batteries should be charged to 14.1V and 13.3V respectively. These voltages are for a battery temperature of 20°C. At higher temperatures, the voltages must be reduced and the amount of compensation is also dependent on battery chemistry.

Typically, lead acid batteries require a temperature compensation of -20mV/°C while Gel-Cell batteries require -25mV/°C compensation.

Clearly, a low-cost charger has no means for setting the required cyclic voltage and nor can it provide the float voltage setting or temperature compensation for these voltages.

Our new charger provides a 3-step charge cycle comprising an initial bulk charge, an absorption phase and then a float charge. A separate equalisation charge mode is available after the absorption phase, if required. Equalisation is important for deep-cycle batteries and should be run three to four times a year.

Our charger includes an LCD that shows charging mode and temperature plus battery voltage and charging current. The display can be set to show the battery amp-hour (Ah) setting, battery type and whether equalisation has been selected.

Battery capacity

A charger must not supply too much charging current to the battery. The optimal charging current is related to the capacity of the battery and its internal chemistry. Our charger sets the initial charge to 25% of the battery's amp-hour (Ah) capacity. For example, for a 40Ah battery, the initial charging current will be 10A. For higher capacity batteries, the charging current will be limited to 16.6A, the maximum that the charger can deliver.

During the initial charging phase, the display shows **BULK** on the top line, while the second line shows the temperature, voltage and current. For example, the display might show **26 Deg C**, **14.2V** and **15.0A**. The °C reading is measured by an external temperature probe, normally placed on the battery case. The voltage and current readings are the battery terminal voltage and the charging current, respectively.

During bulk charge, battery voltage will gradually rise from an initial 12V (or whatever the initial no-load voltage is) towards the cyclic voltage. The battery voltage is continuously monitored and the charger detects when it reaches the cyclic voltage threshold. The cyclic voltage is the value selected for the particular battery type and is compensated with respect to temperature.

When the battery reaches the cyclic voltage, the charger switches over to the absorption phase. This is shown as **ABSORPTION** on the display, while the second line continues to show temperature, voltage and current. During this phase, the cyclic voltage is maintained by adjusting the current.

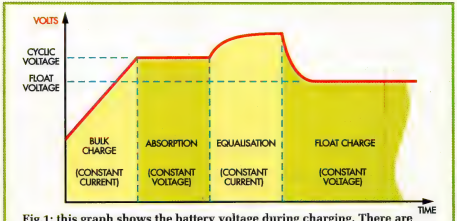


Fig.1: this graph shows the battery voltage during charging. There are three steps to the charging cycle: an initial bulk charge, an absorption phase and then a float charge. An optional equalisation charge phase is also available for deep-cycle batteries.

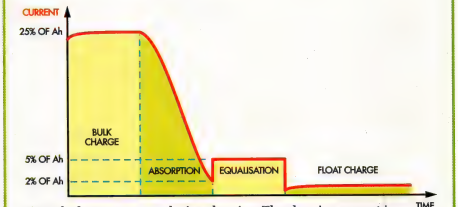


Fig.2: the battery current during charging. The charging current is maintained at 25% of Ah during the bulk charge and then tapers off during the absorption phase. It is then fixed at 5% of Ah during the (optional) equalisation process. When the battery reaches the float voltage, a small charging current maintains it at this level.

The initial stages of the absorption phase maintain the charging current at a similar value to that during the bulk charge. However, as time goes on, the current will be reduced so as to maintain the constant cyclic voltage across the battery. This reduction in current is an indication of battery charge so that when the current falls to around 2% of charge, the battery can be considered to be around 90% charged.

At this point, the charger switches to float or equalisation.

Equalisation sets the current to 5% of the battery Ah and charges for another three hours. Equalisation breaks down sulphation on the plates and thus extends the life of the battery. It also makes sure that each cell within the battery is fully charged, to equalise the cells.

During this phase, the display shows **EQUALISATION** and also shows the temperature, voltage and current. The battery voltage is likely to rise above 16V during this phase and this will cause the display to show **--.-V**. The maximum battery voltage is restricted to the setting of the over-voltage limit. Equalisation should be run only a few times per year since it will reduce battery capacity if used too often.

Finally, the charger switches to float and the display shows **FLOAT**. This takes place at a lower voltage to that of the absorption phase and is temperature compensated. The battery is then left connected to the charger to further increase the charge by a few percent and also to prevent self-discharge. The

Main Features

- Suitable for 12V lead acid batteries
- LCD shows charging phase and settings
- Temperature, voltage and current metering
- 3-step charging
- Optional equalisation phase
- Battery temperature compensation
- 16.6A charge capacity
- Initial trickle charge when battery voltage is low
- 4 preset battery chemistry settings
- 2 adjustable specific battery settings (can be set for 6V batteries)
- Correction for voltage drop across battery leads
- Wide battery capacity range (4-250Ah) in 18 steps

entire charging process is shown in the accompanying graphs (Fig.1 & Fig.2).

Fig.1 shows the battery voltage during charging while Fig.2 shows the battery current. As shown in Fig.2, the charging current is maintained at 25% of Ah during the bulk charge and then tapers off during the absorption phase. It is then fixed at 5% of Ah during the (optional) equalisation process.

The current subsequently normally drops to near zero immediately after absorption (or equalisation) and then the battery drops to its float voltage level. This may take some considerable time. When the battery reaches the float voltage, a small charging current maintains it at this level.

Note that Gel-Cell (SLA) and AGM batteries can accept a higher charge rate than the 25% of Ah delivered by the charger. To achieve this, the Ah setting on the charger can be increased to a value that is about 1.6 times the actual Ah of the battery.

For example, for a 40Ah battery you can use the 60Ah setting. This will increase the current to about 40% of Ah during bulk charge. In addition, the point at which the charger switches from the absorption phase to float charge will increase by the same proportion – ie, from 2% to about 3% – but should be of no consequence.

The equalisation current will also be increased by a factor of 1.6. As a result, if equalisation is selected, the Ah reading should be set to the correct value.

Note that there is no point in increasing the Ah setting for batteries that are above 40Ah in capacity because the charger can only deliver a maximum of 16.6A, as noted above.

Safeguards

There are various safeguards incorporated into the charger to prevent possible damage to the battery. First, at the beginning of bulk charge, the battery voltage is checked to see if it is above 10.5V. If it is below 10.5V, the charging current is limited to 2% of the selected Ah value, until it rises to a level where it is safe to apply 25% of Ah current. Note that there is a facility to charge a 6V battery and the equivalent safety threshold is then 5.2V.

Second, the duration of the absorption phase is not just set by a timer, as in some commercial designs. A timer on its own would not prevent the absorption phase re-running for the duration again should the battery be recharged before it has been discharged. Excessive recharging at the cyclic voltage will cause grid corrosion in the battery, leading to reduced battery life.

So as well as timeout, our charger incorporates a low current detection set at 2% of the battery Ah, at which point float charge is initiated. This feature means that if the battery is recharged before it is discharged, the bulk charge and absorption phase will be short and float charge will happen almost immediately.

In addition, equalisation will not occur unless it is selected manually. As a further precaution, if the battery temperature rises above 40°C, equalisation will not occur after the absorption phase, even if it is selected. Similarly, if the battery temperature rises above 40°C during equalisation, the charger will switch over to float mode.

Finally, if the battery voltage rises above the over-voltage setting, the charger will switch off and show **BATTERY ?** on the display.

User settings

When the charger is switched on, the display prompts the user to select the battery settings: Ah, battery type and whether equalisation is required. Selecting Ah (battery capacity) sets the correct charge rate. The display shows **BATTERY AMP HOUR** on the first line and **<200Ah>**, for example, on the second line. At this stage, the charger is not delivering current and the desired battery Ah is set using the "<" and ">" switches.

The second battery setting is the battery type and should also be selected or checked by pressing the set switch again. The display now shows **BATTERY TYPE** on the first line and **<LEAD ACID>**, for example, on the second line. The battery type can be selected using the "<" and ">" switches to change the settings. For example, the Gel-Cell, AGM, Calcium/Lead, Specific #1 or Specific #2 batteries could also be selected.

The third battery setting is for equalisation. Pressing the set switch will have the display show **EQUALISATION** on the first line and **<OFF>** on the second line. Pressing either the "<" or ">" switch will change this to **<ON>**. Equalisation will then occur after the absorption phase.

Charging will not begin until the start switch is pressed. If the battery is not connected, the charger will not place any voltage on the battery clips. This prevents any sparking at the terminals when connecting the battery while the charger is switched on.

Note that after charging has started, the switches become locked so that the settings cannot be changed. This feature will prevent any tampering with the settings during charging. The set switch will only operate if it is pressed before 25% of Ah current is reached. If the switch is pressed during this time, charging will cease. Charging can then be restarted with the start switch.

A jumper can be removed from within the charger for automatic starting when power is applied. Automatic starting is a useful feature in the event that the charger is only ever used on one particular battery. Should the battery settings require changing, the set switch can be pressed as soon as power is applied to bring up the battery settings on the display. Again, this will prevent charging until the start switch is pressed.

Another jumper must be removed from within the charger in order make changes to the Specific #1 and Specific

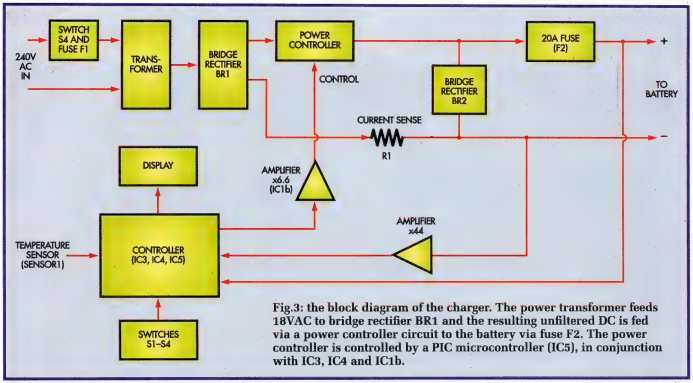


Fig.3: the block diagram of the charger. The power transformer feeds 18VAC to bridge rectifier BR1 and the resulting unfiltered DC is fed via a power controller circuit to the battery via fuse F2. The power controller is controlled by a PIC microcontroller (IC5), in conjunction with IC3, IC4 and IC1b.

#2 battery parameters. This prevents tampering with the parameters.

Should the battery clips be removed from the battery terminals during bulk charging, the charger will either go to the absorption phase or charging will stop and the display will show **BATTERY ?**. The charger will then need to be switched off and on again using the mains switch to initiate the original charging phase.

Fail-safe protection has been incorporated for battery temperature compensation. If the temperature probe is not connected or has gone open circuit, then the battery temperature is assumed to be 40°C. This reduces the cyclic and float voltages to prevent damage to the battery, even in high ambient temperatures. The display also shows two dashes (--) in place of the temperature reading, to indicate a fault in the temperature reading.

Finally, the circuit is protected against reverse battery connection by a 20A fuse.

Charger protection

A 3A slow-blow fuse protects against failures in the mains transformer and the charger circuit, while the abovementioned 20A fuse protects against output short circuits. Fan cooling for the heatsink is provided, with a thermostat cutting in and switching the fan on when the temperature rises above 50°C. If this cooling system fails, a second thermal cutout set at 70°C shuts down the charger.

Over-voltage and over-current limiting are also provided, via the circuit itself and via software control. The software is arranged to switch off the charger if the output goes above 16V during normal charging (except during equalisation) or the charging current rises above 20A. An over-current fault will cause the display to show **<OFF>**.

The over-voltage and over-current thresholds are set using trimpots, to 17V and 18A respectively.

Voltage sensing

When charging a battery, it can be difficult to obtain an accurate reading of the voltage right at the battery terminals. This is because there will be a voltage drop along the leads due to the current flow. Some battery chargers overcome this problem with separate voltage sensing leads but unless the leads are moulded together, they can be a nuisance and become tangled.

Reserve Capacity

Some battery manufacturers use the term reserve capacity (RC) to specify battery capacity and this is distinct from the more readily understood amp-hour (Ah) rating of the battery. The two specifications are not directly interchangeable.

The Ah capacity refers to the current that can be supplied over time (in hours) and is usually specified over a 20-hour period. So a 100Ah battery should supply 5A for 20 hours, by which time the battery voltage will be down to 10.5V. At higher currents, the capacity will be less than 100Ah due to increased losses within the battery.

Reserve capacity (RC) is specified in minutes. It specifies how many minutes the fully-charged battery can deliver 25A before the voltage drops to 10.5V. For example, a battery with an RC of 90 will supply 25A for 90 minutes (1.5 hours). This can be converted to Ah by multiplying RC (in this case 90) by the current (25A) and then dividing by 60 to convert from minutes to hours. Thus a battery with an RC of 90 has a capacity of 37.5Ah. In practice, the Ah capacity would be considerably higher if measured at the 20-hour rate.

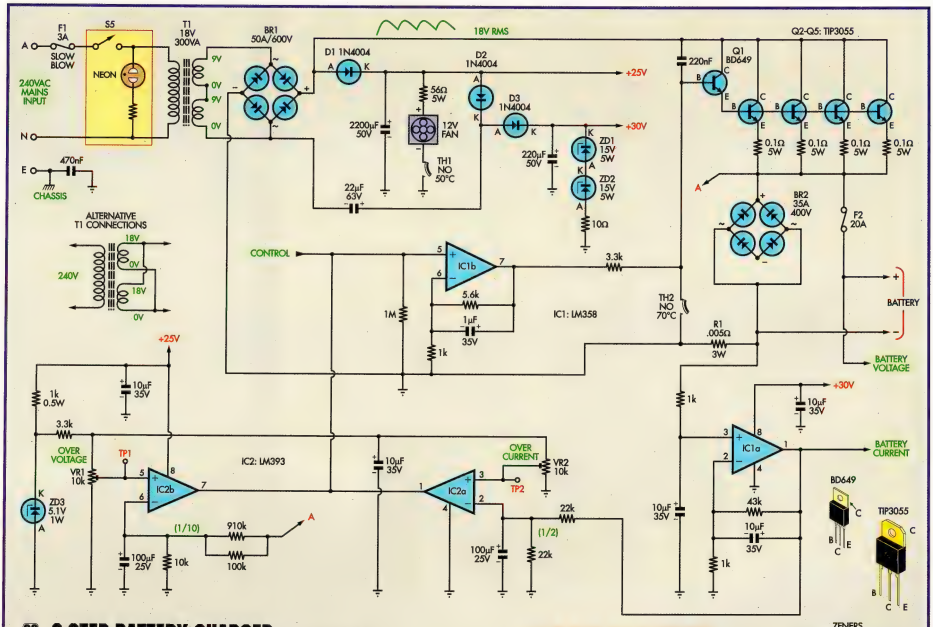


Fig.4: the power section of the 3-Step Battery Charger. The output from the bridge rectifier (BR1) supplies the power controller which consists of transistors Q1-Q5. This circuit is controlled by op amp IC1b, in turn controlled by IC2a, IC2b and microcontroller IC5 (see Fig.5).

For our battery charger, we use a pseudo remote sensing technique to do away with the need to have separate sensing leads. This method calculates the voltage drop produced by the charging current and subtracts this from the voltage measured inside the charger (it assumes a certain resistance in the battery leads and the current sensing resistor). The result is a very close approximation of the true voltage at the battery terminals.

Specific battery parameters

As mentioned, the Specific #1 and Specific #2 battery selections can be adjusted to suit particular battery types. The parameters that can be altered are the cyclic voltage, the float voltage and the temperature compensation. The cyclic voltage and float voltages can be obtained from the manufacturer and must be specified at 20°C (68°F).

In order to change these parameters, jumper JP2 must be removed from inside the charger. When this is done and power is applied, the charger function will be off and the display will show **SPECIFIC #1** on the first line and then **14.3V CYCLIC 20 Deg C** on the second line. This is the initial cyclic voltage set for the Specific #1 battery at 20°C. You can then change the cyclic voltage using the "<" and ">" switches in 100mV steps over a range from 0.0V to 15.7V. Note that this range also allows charging a 6V battery.

Pressing the set switch will cause the display to show the float voltage for the Specific #1 battery type. This will initially be 13.3V and can be set in 100mV steps over a range of 0.0V to 15.7V.

Pressing the set switch again will show the temperature compensation value for the Specific #1 battery. Initially, the display will show **-36mV/Deg C**. This can be changed in 1mV steps from 0mV/°C to -63mV/°C using the "<" and ">" switches.

Pressing the set switch again will show the cyclic and float voltages and the temperature compensation value for the Specific #2 battery. Adjusting these is the same as changing the Specific #1 settings. When adjustments are complete, JP2 can be replaced inside the charger for normal operation.

Block diagram

Fig.3 shows the block diagram of the charger. The power transformer feeds 18VAC to bridge rectifier BR1 and the resulting unfiltered DC is fed via a power controller to the battery via fuse F2. Should the battery be connected the wrong way around (reverse polarity), bridge rectifier BR2 will conduct and blow the 20A fuse (F2).

The power controller section is itself controlled by a PIC microcontroller (IC5), in conjunction with IC3, IC4 and IC1.

Circuit description

The circuit for the 3-Step Battery Charger is split into two sections – Fig.4 (Power) and Fig.5 (Control). This is a linear design rather than switchmode. We opted for this approach in order to use more readily available components and to simplify construction, without the need for specialised high-frequency transformer assemblies, coils and high-frequency capacitors.

A linear circuit is not as efficient as a switchmode design but it is easier to build and is more rugged. Also, much of the heat generated by the charger is due to losses in the main bridge rectifier and this would be much the same, regardless of whether we had used a switchmode or a linear design.

Looking at Fig.4 (Power) first, the power transformer is a 300VA toroidal type feeding 18VAC to the bridge rectifier which then supplies the power controller which comprises transistors Q1-Q5, connected as a compound emitter follower. Q1 is a power Darlington and it drives the commoned bases of four TIP3055 NPN power transistors (Q2-Q5). These power transistors each have 0.1Ω emitter resistors to help equalise the load current.

In operation, the emitters of transistors Q2-Q5 "follow" the voltage applied to the base of Q1 (hence the term "compound emitter follower"). Adjusting the base voltage on Q1 controls charging so that the higher the voltage on Q1's base, the more the power transistors conduct and the greater the current into the battery. The 220nF capacitor between the base and collector of Q1 prevents bursts of oscillation that would otherwise occur as the transistors begin to conduct on each cycle of the pulsed DC voltage from the bridge rectifier.

Op amp IC1b supplies the base current to Q1 via a 3.3kΩ limiting resistor. This amplifier has a gain of 6.6 to multiply the control voltage range at pin 5 from 0-5V to 0-33V. The 30V supply to IC1b and its limited output swing does restrict the range to more like 0-28V but this is more than enough to fully drive the output transistors. The 1µF capacitor across the 5.6kΩ feedback resistor provides rolloff above 28Hz to prevent op amp IC1b from oscillating.

A 70°C thermostatic switch, TH2, provides over-temperature protection. This is mounted on the main heatsink and when it closes (when the temperature exceeds 70°C), it shunts base drive from IC1b to ground and this stops the charger from supplying current to the battery.

Note that IC1b's output is prevented from being directly shorted by a 3.3kΩ current limiting resistor.

Current monitoring

The charging current flow is measured by amplifying the voltage produced across a 0.005Ω resistor (R1)

Temperature Compensation

The temperature compensation required by manufacturers is usually shown as a graph of voltage versus temperature. You need to convert this to mV/°C. To do this, take the difference between the voltages at two different temperatures and divide by the temperature difference.

For example, a battery graph may show the cyclic voltage at -10°C to be 15V and at 40°C it may 14.2V. So (14.2 - 15)/50 is -16mV/°C.

Some graphs of batteries show the float temperature compensation to be slightly different to the cyclic compensation. In this case, the compensation will need to be a compromise between the two values.

Note that it may be possible to obtain a better value, that is closer to the requirements for both voltages, if the graph is interpreted over a smaller temperature range, consistent with the temperature conditions under which you would expect to be using the charger.

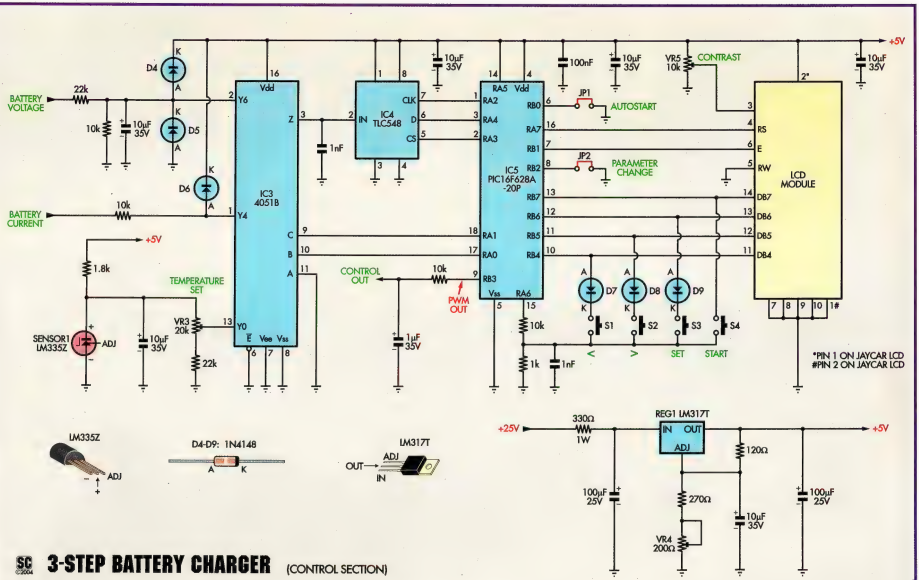


Fig.5: the control section is based on PIC microcontroller IC5. It works in conjunction with IC3, a 4051 analog 1-of-8 selector which monitors the battery voltage, current and temperature (via Sensor 1). IC4 converts the selected analog data from IC3 into 8-bit serial data which is then processed by the microcontroller. The microcontroller produces the control signal for IC1b, drives the LCD module and processes the inputs from switches S1-S4.

using IC1a which has a gain of 44. Filtering is included at the input and across the feedback path for IC1a, to convert the pulsating charge current to an average value. Hence, the 10µF capacitor at pin 3 filters the current by rolling off signal above 16Hz, while the 10µF capacitor across the 43kΩ feedback resistor rolls off frequencies above 0.37Hz.

IC1a's output is applied to pin 2 of the over-current comparator, IC2a, via a voltage divider comprising two 22kΩ resistors and a 100µF filter capacitor. The non-inverting input, pin 3, is connected to trimpot VR2. VR2 is adjusted so that IC2a's output goes low when the charge current goes above 18A.

When IC2a's output goes low, it pulls pin 5 of IC1b low. This causes pin 7 of IC1b to go low, removing the drive to Q1 and to the battery.

Over-voltage protection

The battery voltage is monitored at point A on the circuit – ie, at the junction of the four 0.1Ω resistors (for Q2-Q5) – and fed via a voltage divider to pin 6 of comparator IC2b. This is compared to a reference voltage on pin 5, from the wiper of trimpot VR1. This is set so that IC2b's output goes low when the battery voltage goes above 17V. The low output of IC2b will shut down the drive to Q1, as before.

Note that IC2a and IC2b are comparators with open-collector outputs. When their outputs are off, they do not affect the drive to pin 5 of IC1b.

Note also that when the output of IC2a or IC2b goes low to stop the drive to Q1 (via IC1b), the over-current or over-voltage condition will cease. As a result, the relevant comparator output will go open circuit again to restore the drive to Q1's base. If the fault still exists, drive will again be removed and so this cycle will continue – ie, the charger will cycle on and off at a slow rate.

Zener diode ZD3 provides a 5.1V reference supply for trimpots VR1 and VR2 and this is further reduced by a 3.3kΩ resistor so that each trimpot has a nominal 0-3V range.

DC supply rails

The 25V supply for IC2 and the fan is derived from the rectified output of BR1 via diode D1. This rail is filtered using a 2200µF 50V capacitor.

Diodes D2 and D3 form a voltage doubler which is fed from the AC input

Specifications

Bulk Charge: constant current charge at 25% of Ah.

Absorption Phase: constant voltage charge at cyclic voltage until current drops to 2% of Ah or timeout of 2.5 hours (which ever comes first).

Float Charge: constant voltage charge at float voltage.

Equalisation: optional after absorption phase. Constant current at 5% of Ah for three hours. Equalisation switched off if temperature rises above 40°C.

Battery Ah Settings: 4, 8, 12, 16, 22, 24, 30, 40, 60, 80, 90, 100, 125, 150, 175, 200, 225 & 250Ah.

Battery Type: Lead Acid, Gel-Cell (Sealed Lead Acid or SLA), AGM (Absorbed Glass Mat) and Calcium Lead, plus adjustable settings with Specific #1 and Specific #2 battery selection.

Lead Acid Parameters @ 20°C: cyclic 14.2V, float 13.4V, compensation -20mV/°C.

Gel-Cell Parameters @ 20°C: cyclic 14.1V, float 13.3V, compensation -25mV/°C.

AGM Parameters @ 20°C: cyclic 14.4V, float 13.3V, compensation -36mV °C.

Calcium/Lead Parameters @ 20°C: cyclic 15.0V, float 13.8V, compensation -20mV/°C.

Adjustable parameters (Specific #1 and #2): cyclic 0.0V to 15.7V in 100mV steps, float 0.0V to 15.7V in 100mV steps, compensation 0mV/°C to -63mV/°C in 1mV steps (changed with JP2 out).

Low Battery Voltage Detection: 10.5V for 12V battery (5.2V for 6V battery).

Low Battery Charge Current: 2% of Ah.

Temperature Compensation: operates from -10°C to 99°C (voltage fixed at -10°C setting for temperatures below this).

Open Circuit Temperature Probe Default: compensates assuming 40°C. Display shows (–).

Temperature Measurement: display shows from –9°C to 99°C in 2°C steps. Temperatures below –9°C show as a LO. Temperatures above 99°C shown as (–). Display refreshes reading every 0.2 seconds.

Voltage Measurement: from 0-16.0V with 100mV resolution. Display shows –.-V above 16V. Display refreshed every 0.2 seconds.

Current Measurement: from 0-25.5A with 100mA resolution. Display readings refreshed approximately every 1 second.

Fan Cut In Temperature: 50°C.

Fan Cut Out Temperature: ~40°C.

Over-Temperature Cutout: 70°C.

Hardware Over-Voltage Limit: adjustable.

Hardware Over-Current Limit: adjustable.

Software Monitored Over Voltage Limit: 16V at charger output (not operational during equalisation).

Software Monitored Over Current Limit: 20A.

This is the view inside the prototype. Most of the parts are mounted on three PC boards: a power board, a control board and a display board which mounts vertically behind the front panel. The assembly details are in Pt.2, next month.

of the bridge rectifier via a 22µF capacitor. The voltage across the following 220µF capacitor is then limited to 30V by series-connected zener diodes ZD1 & ZD2 and a 10Ω resistor.

Note that the two zener diodes are rated at 5W because the peak current through them is too high for 1W devices. The 10Ω resistor in series with the zener diodes is included to reduce the peak current.

Why use a zener diode shunt rather than an adjustable 3-terminal regulator (such as an LM317) to obtain the 30V rail? Because the wide range of transformer loading means that an LM317 could not do the job.

By the way, the reason we need a 30V supply for IC1 is so that IC1b can drive the base of Q1 above the 25V peak voltage of the unfiltered DC supplying the power transistors.

The heatsink cooling fan is powered from the 25V supply rail via a 56Ω 5W resistor when ever the 50°C thermostat switch is closed. The 56Ω resistor reduces the fan supply to around 12V when the fan is running.

Control circuit

Fig.5 shows the control circuit which comprises IC3, IC4, PIC microcontroller IC5, the LCD module and associated components. IC3 is a 4051 one-of-eight analog switch. In our circuit, we use only three of the eight inputs. One selects the battery voltage at pin 2, the second selects the current signal at pin 1 and the third takes the temperature signal at pin 13.

The voltage input comes from the positive battery terminal via 22kΩ and 10kΩ resistors which divide by a factor of 0.31. Voltages above 5V at pin 2 are clamped using D4, while voltages below 0V are clamped using D5. The latter is required to protect IC3 against reverse battery connection.

The current signal comes directly from the output of IC1a (see Fig.4) via a 10kΩ series resistor. Battery temperature is measured using an LM335 (Sensor 1). This provides an output that is a nominal 10mV/°C. The offset voltage at 0°C is typically 2.73V. Trimpot VR3 divides the Sensor 1 output so the voltage can be set to vary by 9.8mV/°C. This adjustment is required to cater for individual variations in the output of these devices.

The temperature, voltage and current signals to IC3 are selected by using the B and C inputs at pins 10 and 9, respectively. When the B and C inputs are set to 0V, the temperature signal (pin 13) is selected. When B is low and C is high, the current signal (pin 1) is selected and when B and C are both high, the voltage signal (pin 2) is selected.

The selected signal is fed to IC4, an 8-bit analog-to-digital (A/D) converter. IC4 produces serial data at its pin 6

output and this is fed to the RA4 input (pin 3) of PIC microcontroller IC5. The RA2 and RA3 lines from IC5 drive the clock and chip select inputs on IC4.

IC5's internal oscillator runs at 4MHz. This gives a timebase accuracy of about 2%, which is more than adequate for this application.

LCD & pushbuttons

The LCD module is driven from the RB4-RB7 outputs of IC5, while control over the display is provided by driving the Register Select (RS) and Enable (E) inputs at pins 4 and 6 respectively. The RB4-RB7 data lines also connect to switches S1-S4. When a switch is closed and its data line is high, it can pull the RA6 input (pin 15) high.

Diodes D7-D9 are included to prevent the data lines from being shorted should more than one switch be pressed at a time.

The RB0 and RB2 inputs provide the jumper options (JP1 and JP2). Normally, these inputs are pulled high via internal pullup resistors and pulled low if the relevant jumper is installed. JP1 is removed for auto start and JP2 is removed for the parameter change.

In response to its stored software, IC5 produces a pulse-width modulation (PWM) output at pin 9. This swings between 0V and 5V at about 4kHz, with a duty cycle ranging from 100% (fully high at 5V) through to zero (fully low at 0V).

By filtering this waveform, the resulting output will be a DC voltage which can be varied in steps of around 5mV (ie, 10-bit resolution). The filtering is provided by a 10kΩ resistor and 1µF capacitor and this becomes the control voltage fed to IC1b on the power circuit of Fig.4.

The control circuit runs from a 5V supply derived from an LM317 adjustable regulator (REG1). It is fed from the +25V rail via a 330Ω resistor which reduces power dissipation in the regulator. Trimpot VR4 is set so that the output voltage is as close to 5V as possible. This calibrates the voltage and current readings measured by IC3.

The chassis and circuit ground are connected together via a 470nF capacitor, included to shunt any noise signals present on the supply.

Next month, we will give the full parts list, assembly details and set-up procedure. **SC**

Looking For More Info?

For more information on battery charging, readers can refer to "Motorhome Electrics – And Caravans Too!" by Collyn Rivers. We reviewed this in the February 2003 issue of SILICON CHIP.

In this book, Collyn spells out the desirable charging methods for lead-acid batteries. Specifically, he makes note of the requirement to compensate charging with respect to temperature and with respect to battery chemistry.

In Australia, temperature compensation is a mandatory requirement for a quality charger. This is because we have a wide range of temperatures across the continent and into Tasmania. Typically, temperatures can extend from the minus figures through to well above 40°C in the shade.

The book is available from the Caravan & Motorhome Books, PO Box 3634, Broome, WA 6725.

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SERVICEMAN'S LOG

It's time I bought a new TV set!

It's really time I got myself a new TV set and threw the old one out. Then again, maybe not – my rare 9-year-old set recently came in handy when an identical set came in for repair.

My own personal TV at present is a 1995 Philips 32PW977/75 (GFL2.2A chassis) which is a fully-featured widescreen set. The reason I own it is that it has an annoying intermittent contrast level problem which over the years successive technicians – including myself – have failed to repair. However, the general consensus is that it's the picture tube that's causing the problem and this is far too expensive to replace.

Most of the time though, the picture is perfectly acceptable to watch and it only plays up occasionally.

Recently, I had an identical set come in for repair. This was somewhat surprising, as this fully-imported model is as expensive as it is rare. The fault with this particular set was no picture.

When removing the back from this set, you must remember to unscrew and remove the sub-woofer cover first. That's because the connecting lead is rather short and you can otherwise end up ripping it out of the PC board.

This set, commensurate with its features, has a lot of electronics on board. This meant that the easiest way for me to locate the problem area was to initially try swapping modules with my own set.

I did this and it didn't take long to trace the problem to the CRT socket board (R). With my board in this set, the picture was excellent and the intermittent contrast fault did not move over from my set.

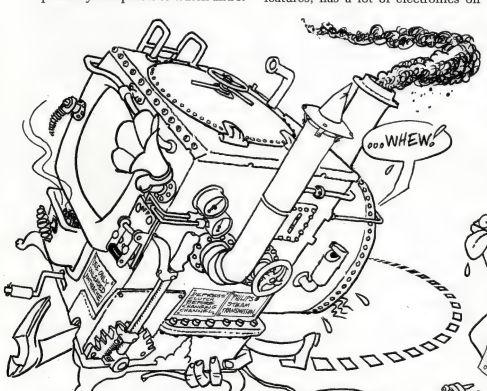
An examination of the faulty board soon revealed that R3273 (10Ω) which supplies the 200V rail was open circuit, as was R3272 which supplies the 12V rail. The circuit shows the latter to be 6.8Ω but the set had an 18Ω unit fitted (by the factory) in this location.

The reason these two fusible resistors had failed was because all three TDA6111AQ/N3 output ICs (7230, 7240 & 7250) were short circuit to ground. I ordered and replaced all these parts and then fitted the board to my own set to test it.

Surprisingly, the intermittent low contrast problem I previously had was now suddenly permanently low contrast. What's more, when I swapped the boards over, my set was still permanently suffering from low contrast.

My next step was to check the BC-INFO (Beam Current) line. This measured 5.2V, which is roughly what it is supposed to be. However, the EHT-INFO line (beam limiting from the flyback transformer) measured 0V and a quick check with an ohmmeter indicated that this line was short circuited directly to the chassis ground.

Now this line also goes directly to the CRT aquadag and disconnecting the lead (plug R35) from this to the CRT socket indicated that the short was actually between the tube and chassis. As a result, I disconnected all the earth leads between



IT'S REALLY TIME I GOT MYSELF A NEW TV SET AND THREW THE OLD ONE OUT... THEN AGAIN...

Items Covered This Month

- Philips 32PW977/75 TV set (GFL2.2A chassis)
- JVC video cassette recorder
- JVC AV-28S4E TV set (MXIV chassis)
- Telefunken SDX290
- Hitachi HMV-8300 Stereo Amplifier
- NAD 317 Stereo Amplifier

the chassis and the picture tube (in fact, all the leads I could see) but the meter still showed a short circuit between the aquadag and the chassis.

How could this be? To the naked eye, the tube looked completely isolated from the TV chassis but the meter was telling me the opposite. As a result, I cast my net wider and examined the CRT mounting brackets and the loudspeakers but nothing immediately caught my eye.

I then went through the motions of completely isolating everything from the front shell of the cabinet and the TV chassis. I unplugged the righthand set of loudspeakers while watching the meter – no change. However, when I unplugged the lefthand set of speakers, the short suddenly cleared.

So how was this possible if there is absolutely no connection between the tube and the speakers? Well, of course there had to be. The set has two elliptical speakers on each side plus a tweeter and the tweeters are connected via a 4.7µF 50V bipolar capacitor. And as I subsequently discovered, the lefthand side capacitor was tucked down hard between the speakers and the tube, with one of its leads touching the rim-band of the tube.

Moving the capacitor just a fraction was enough to clear the short (the impedance of the tweeter is only 6Ω to ground), which accounted for why it was intermittent. Reconnecting everything brought the EHT-INFO line up to 9V for zero beam current (black) and 5V for 3mA (peak white). And the contrast was now strong and steady.

Just why the other set destroyed its video amplifier IC is hard to determine, as the picture tube measured perfectly (no intermittent shorts) with the analyser. One possible reason is that the SCAVEM board shorted against the CRT socket panel. This board is held on with a plastic band around the CRT neck and this band fractures with age and heat.

The slow JVC video

An old friend of mine brought in his beloved JVC video complaining about intermittent no or slow rewind. Having done many of these over the years, I said I could fix it for him.

The problem is caused by dried-up grease in the idler clutch assembly and the fix is easy: remove the old grease, clean the area, re-lubricate the assembly and reassemble everything. To do this, I first had to remove the deck, which isn't difficult, after which the

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job was quite straightforward apart from reconnecting a couple of the connectors.

However, I was amazed to find when I switched it on afterwards that there was no display. This was because when I had re-inserted one of the worn flat ribbon cables, one of the conductors had bent back and shorted out.

That was easily fixed but then I noticed that the playback picture was snowy, as though the heads were faulty or worn. I was sure I hadn't damaged the heads in any way but the envelope waveform on the CRO was awful – so I quickly replaced the heads with those from another machine but the problem remained the same.

Feeling somewhat miffed by this, I pulled the deck out again and examined the head assembly. And when I removed the head amplifier plug, I noticed that not all the pins were level – one was sitting 1mm lower than the others.

Examining this more closely, I found it had been pushed through the board and broken the solder land to the copper (the solder is all that holds it in place). I resoldered it and pushed the pin through before using hot melt glue to keep it in place. I then reassembled everything and this time it all worked fine.

What I should have done in the first place was sell my mate a new video. I never learn.

The old JVC set

I was called out to a 1994 JVC AV-28S4E (MXIV chassis), its owner complaining of intermittent (at first) and now no vertical deflection (horizontal white line) before the set went dead.

Now I had never seen this model before but fortunately managed to bludge a circuit off a mate of mine before calling around. I wouldn't normally have agreed to a house call on a 10-year-old set such as this but logistics and hunger forced me to have a go.

The only advice my friend (a JVC technician) gave me when he lent me the circuit was watch for the on/off switch shaft which, apparently, is really easy to break when the set is in the service position.

It didn't take long to work out why the set was dead. Q521 (BU508AFI) – the line output transistor – was short circuit and of course I didn't have one with me. I could go back to the workshop and get one but in the end I decided to take the chassis with me.

I ordered and fitted the correct transistor when it arrived but I had no idea as to why the original transistor had failed. Nor did I know what was causing the vertical deflection problem.

Examining the chassis, I noticed that C543 – a 2200µF 16V electrolytic capacitor – looked suspect. Its heat-shrink covering had been shrunk by excessive heat and so it was replaced. This is the main smoothing capacitor for the 12V rail.

Of course, the flyback transformer could also have failed but my shorted turns meter suggested it was OK. I then checked for and soldered miscellaneous dry joints, especially around the crystals to the jungle IC (IC201), which can cause intermittent drive pulses and destroy the line output transistor as in other JVC models.

I also found a dry joint underneath some glue at the junction of C508 and C509, which are part of the AFC filter circuits. And I replaced filter capacitor C514 (10µF 50V), which is on the 15V supply to the horizontal drive transformer.

Now what to do about the vertical deflection stages? I decided to play safe and change anything that might be likely to cause a problem. After all, the parts are cheap and the labour isn't, so now was the easiest time to change everything in sight. As a result, I replaced IC441 (TDA 3654) and electrolytic capacitors C443, C444, C446, C448, C467 and C542 – ie, all the electrolytics in the vertical output stage.

When I returned with the chassis, I managed to refit everything back together again without breaking the power switch. And because of space restrictions and the need to refit AV leads, I had to completely reassemble the set and fit it back into its entertainment centre before switching it on.

It really was a relief to see the set come on with a fully-scanned picture. However, after a few minutes, I did notice a problem – one colour was missing, which was annoying. When I removed the back again, I found that this was due to a dry joint on the CRT

panel to one of the output transistors. Resoldering this finally restored the set to full operation.

The dead Telefunken

I sold a secondhand Telefunken SDX290 (Thompson ICC7000+) TV set some years ago to Frank Rogers, a young man in his late twenties who works in the city. Recently, he phoned to say his set had died and just prior to that he could hear "crackling" and smell acrid smoke.

From his description it sounded like the flyback transformer had failed, especially as he lived near the beach. He didn't want to spend much on it (have you ever met anyone wanting to spend money on repairs?), so I suggested he bring the set in and I would check it out.

Frank jumped at this and said he would be round directly. Well, actually he didn't "rock up" for a couple of hours (and he just lives around the corner) but when he did, his face was a picture – a mixture of sheepishness and anger.

Apparently, he had had an accident on the way here. He had placed the set in the back of his station wagon and in his eagerness to get here had reversed really quickly down his driveway before stopping to turn and drive up the road.

The problem was that in his haste, he hadn't closed the tailgate properly. So when the car stopped abruptly, the set didn't. As a result, the tailgate opened and the set tumbled out onto the road!

Being of solid Teutonic construction, the cabinet didn't break but both it and the tube sustained deep scratches. And that meant that Shauna, his wife, no longer wanted his pride and joy back in their lounge room, so he donated the wreck to me.

Being curious, I removed the back and checked the set out. The flyback transformer was OK but the horizontal coupling capacitor – CW01 0.68µF 250V (mounted on sub-board DFH7070) – had failed big time. Replacing it fixed the picture and sound perfectly but nothing could be done about the deep scratches.

I tried asking a few local glaziers about polishing out the scratches on the front of the picture tube but no-one would touch it with a barge pole – they wouldn't even look at it. This is a perennial problem for me as often I get tubes with scratches and as yet, I haven't found a satisfactory method of buffing them out.

Of course, I didn't phone Frank back to tell him that the cost of the repair would have been quite minor – that really would have been rubbing salt into an already gaping wound.

Standards conversion

A Panasonic TV from Brazil came in to be modified so that it would work in Australia. In the old parlance, CCIR System M is a mixture of American and European TV systems. It uses the American channel frequencies and spacing, plus 525 lines and 60Hz, and the German PAL-D colour system. Its usable voltage range is from 100V to 250V AC.

Modifying it to work in Australia (System B/G) is fairly straightforward until you get to the colour system. In Brazil, the sub-carrier is 3.576MHz, whereas we are 4.43MHz, so we had no colour. Changing the ceramic filters for the RF, IF and decoder section was relatively

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easy but trying to get the jungle IC to lock into colour finally defeated us, as it requires changes to the microprocessor and EEPROM to switch the multiplier/divider connected to the 16MHz reference crystal.

In the end, the work-around was to get a digital set top box with colour difference outputs that could plug into the DVD input sockets.

Dead Hitachi amplifier

A dead 1997 Hitachi 200 watt "Dynaharmony" series E amplifier (HMV-8300) was brought in for repair. The reason it was dead was because the protection circuit had been enabled, as the left channel had a 15V DC output offset voltage.

The power supply was giving the correct voltages at ±39V, ±95.8V, 14.7V and 10.6V.

Careful measurements using a multimeter then revealed that R711 (100Ω) was open circuit. Unfortunately, replacing it and then powering up this big amplifier with a 100W light globe in series with the AC input didn't fix the problem.

This time, the offset voltage was -4V but at least the globe didn't light up, so there didn't appear to be any major faults that could cause catastrophic damage. Further measurements using a multimeter then showed that R710 measured 1.5kΩ, whereas it should have been 100Ω. Hoping that this would solve the riddle, I replaced it and switched the amplifier on – forgetting to put the safety globe in circuit.

Big mistake – after the smoke had cleared, I found I had blown Q714, Q715 and Q710, all expensive output transistors.

When I got back to square one again, I switched on but this time with the globe in place. The output offset was still at -4V and the globe showed that too much current was being drawn. I then found that the output stage bias was too high, at 200mV instead of 10mV.

As a result, I took a closer look at the Bias Control/Idle Current Adjust area of the circuit. And I hit pay-dirt – a 12V zener diode (CR721L) on the other side of the board was short circuit. Replacing this finally fixed the amplifier.

While I was at it, I decided that it would be a good idea to also examine the righthand channel of the amplifier. This revealed that the same two resistors were also high in this channel, even though it was still fully functional.

My theory is that the lefthand channel's 100Ω fusible resistors are what caused the zener diode to fail. As a result, they were replaced in the righthand channel as well, to ensure long-term reliability.

Another audio amplifier

Another 1997 amplifier, this time an English-made 80-watt NAD 317 (worth about A$1200), was also brought in. And like the Hitachi unit, it too had a protection problem.

In this case, the protection circuit was being triggered due to a 6V DC output offset in the lefthand channel. Unfortunately, this time I had no circuit diagram, which meant it was going to be difficult, but at least I had one good channel to compare it with.

I began by checking the power supply. This revealed unregulated ±90V rails which were then regulated down to ± 55V, 52V and -12V. These figures all seemed perfectly reasonable at the time. The DC offset for the righthand channel was 0V which is correct, while and the lefthand channel was at +6V as previously stated.

My next step was to check all the transistors and I even replaced the small signal transistors in case of intermittent noise due to breakdown. However, this made no difference and I finally realised that I needed the circuit diagram to make further progress.

As a result, I ordered the service manual and when it arrived, I immediately realised that the power supply voltages were incorrect – even though one channel was still working correctly. There should have been ±52V rails instead of +52V and -12V.

From this information, I found a 100Ω resistor (not marked on the circuit) that was open circuit. This had probably failed due to a large number of leaky capacitors in the power supply (around 20, in fact). I replaced all these and for a while did have sound coming out of the amplifier but then the slow muting circuit cut in intermittently.

I spent a very long time trying to fix this new fault and get this simple circuit to work. The circuit uses IC202 (TA7317) and its output at pin 6 drives, via two thermistors, a relay and Q208 (2SC2240). This, in turn, drives Q207 (2SA970) via a time-constant capacitor (C222), then Q206 and Q205. These then drive the "Protect-On" LED and muting transistors Q101 and Q102 – ie, the muting transistors for each channel.

The problem lay around Q207, which was being randomly switched on. This transistor appeared to be still on even when there was only 0.07-0.055V varying between its base and emitter. However, hitting any component with freezer would make the circuit work.

In the end, I replaced all the components in this circuit and it still kept playing up! Even replacing or shorting Q208 made no difference.

It's the economy, stupid

After spending a prodigious amount of time trying to resolve this problem, it reached the stage of being well beyond economic repair. As a work-around, I simply removed the slow switch-on muting circuit transistor (Q207), resulting in a slight audible click when the amplifier was turned on or off. This wasn't really a big deal and at least the rest of the amplifier now worked!

Sometimes you just have a bad hair day – this was one! It's funny how simple circuits are often more troublesome than complex ones. Of course, it's possible that the transistors, which have a GR suffix, may require higher gain than the ones I fitted and this may be critical in this circuit. **SC**

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5W Super Bright Luxeon LED Hand Torch

Blinding white light!

If you need a super bright torch, this one's for you. If houses a super bright, super white, 5W Luxeon LED for superb performance. •Requires six AA batteries.

NEW! 2004

Cat. ST-3338 **$149.95**

Marvin the Auto-Scan FM Radio Robot

A great radio!

Lift his left arm to control volume, or his right arm to scan for stations! Stands 140mm tall. Requires 4 x AA batteries.

NEW! 2004

Cat. AR-1972 **$19.95**

DUE LATE NOVEMBER

2.4GHz Wireless Audio Video Senders

Watch cable TV all over the house!

Send a signal from a DVD player, set-top box etc., to another room, without the use of any cables! You can use as many receivers as you like, without degrading signal quality. Each unit comes supplied with stereo audio and video transmitter and receiver, mains plugpacks & RCA cables. Transmission range is up to 100m, but depends on the type of construction materials used. **Was $99**

Extra receiver to suit Cat. AR-1833 $69

SAVE $10

Cat. AR-1832 **$89.00**

2.4 GHz Wireless A/V Sender with Remote Control Extender

With the addition of an IR remote control repeater you can change the channel of the source device etc from the other room.

Was $139

Extra receiver to suit Cat. AR-1831 $89

SAVE $30

Cat. AR-1830 **$109.00**

KIT OF THE MONTH

Bed Wetting Alert Kit

NEW KIT

Dry nights - happy kids!

Ref: Silicon Chip Sept '04.

The bed wetting alert uses the wireless transmitter from our witty Remote Controlled Fart Gadget to sound an alarm when the modified transmitter detects any moisture. It works very well, and can help train your child to wake up before they wet the bed, so they can go to the toilet instead. Kit supplied with fart gadget for modification, PCB, and all electronic components.

Cat. KC-5396 **$39.95**

Driveway Automatic Entry Sensor Kit

EXCLUSIVE TO JAYCAR!

NEW KIT

Ref: Silicon Chip Nov 2004.

Automatically open your electronic gates or automatic garage door as you approach in your vehicle, without the use of remote controls! It uses a large coil sensor to detect moving metal (eg a car chassis), which reduces false alarms from animals and people etc. Kit supplied with PCB, silk screened machined case, pre-wound and insulated 5000 turn coil, and all electronic components.

Cat. KC-5402 **$179.00**

A LONG LOST TREASURE!

HKZ-101 Hall Effect Vane

Jaycar has it back!

Previously obsolete, the HKZ-101 has been commonly requested, but difficult to find since Siemens deleted it in 1998. This copy is almost identical, and works very well. See our website for data.

NEW! 2004

Cat. ZD-1900 **$39.95**

12VDC Flexible 21 LED Lights

NEW! 2004

A new lighting option!

They can mount straight, or will easily bend end-to-end, giving you a myriad of mounting options. They are a great low current light source, drawing around 200mA. The tube is 24" (610mm) long, and houses 21 super bright LEDs.

MOUNTS ANYWHERE

White Cat. SL-3950 **$29.95** **Blue** Cat. SL-3952 **$24.95**

Cat. SL-3950 **$29.95** Cat. SL-3952 **$24.95**

New store opening in Hornsby. 130 George Street. NSW. 2077. Opens late November

Our Silverwater Showroom is now open Sundays! 10am to 4pm

IDEAL PROFESSIONAL MULTIMETERS - A COINCIDENCE, BUT NOT A FLUKE!

By contractor grade, the Americans mean that these meters are designed to be used everyday, all day, and are therefore very RUGGED. No matter what silly things you do, you cannot blow these meters up (within specs). For example, set it to ohms scale and plug it into 240V. No problem! You could say it's idiot proof, but who are we to call our customers idiots. They also have a lifetime limited guarantee. No, not what a judge calls 'life', we mean as long as you own the meter, we will repair or replace the product if it becomes genuinely faulty. Beat that!!

True RMS Commercial Contractor Grade DMM

A professional meter jam packed with features, and as mentioned above, it is virtually indestructible, with overload protection on all ranges. It also boasts a lifetime warranty - if you rely on a Multimeter in your workplace or occupation, then this meter is a very sound investment.

- True RMS
- Auto/Manual Ranging
- Analogue Bar Graph
- Auto Power Off
- Temperature
- Relative Mode
- Capacitance
- Frequency
- Data Hold
- Low Battery Indication
- Min/Max/Peak Min/Max
- Backlight

NEW! 2004

Cat. QM-1625 **$449.00**

True RMS Contractor Grade Clamp Meter

The meter will vibrate, yes vibrate, when testing or even near a source of mains. This is a fantastic safety feature if you are in, say, a dark switch-room or you have ear muffs on in a noisy plant room.

- 200A AC Current Capability
- Non-contact voltage 40 to 600VAC
- Capacitance
- True RMS
- Backlight
- Vibration mode to verify AC Voltage
- Harmonics Indicator
- Max Hold
- CAT III 1000V
- Overload protection on all ranges
- Audible Dangerous Voltage Warning
- Low Battery Indication
- Auto Power Off

NEW! 2004

Cat. QM-1628 **$349.00**

128MB MP3 Player with LCD Screen

Great music portability!

It can store up to two hours of MP3 music or four hours of WMA music. It has 5 inbuilt equalisation settings for optimum sound, and can operate just as a USB flash disk.

NEW! 2004

Cat. GE-4001 $149

128MB MP3 Player Backphones

Great when your on the move!

They might look like any other quality stereo back-phones, but these little beauties actually include an impressive MP3 player, battery and all the controls you need to listen to your favourite music. See website for details. DUE LATE NOVEMBER

NEW! 2004

Cat. GE-4002 $149

Memory Card Type MP3 Player

A cheap alternative! It has no internal memory, instead using standard SD cards (available separately), giving you a cheap, high capacity MP3 player. See website for details. Measures just 57(W) x 45(H) x 12(D)mm and runs on 1 AAA battery.

NEW! 2004

Cat. GE-4003 $69.95

The Amazing Flygun!

Keep the kids entertained!

The Amazing Flygun is a safe, fun, and effective method of killing flies and mosquitoes. Launch the spring powered swatter at your target! It is safe, fun and really does work!

KILLS COCKROACHES TOO!

Cat. YS-5545 $7.95

Fog Machine

Great for parties!

It emits a harmless fog that can help create great lighting effects, mystical low lying fog, and more. 240VAC mains powered. Requires Cat. AF-1212 fog juice.

Cat. AF-1210 $99.95

1L Fog Juice for Fog Machine

Cat. AF-1212 $9.95

Heated Foot Massager

Just the thing at the end of the day!

It heats and massages your feet to sooth tired muscles. Operated by a handheld controller, it can be mains or 12VDC powered.

NEW! 2004

Cat. GH-1755 $39.95

Mini Digital Video Camera

Fantastic price! This easy to use camera fits in the palm of your hand!

The recorded video can be transferred to a computer for editing, or simply viewed directly on any TV.

Supplied with camera bag, cables and software.

- 3.1 mega pixel software resolution for stills.
- 1.5" colour LCD screen.
- 5 layer glass lens.
- Requires SD or MMC card
- Internal microphone and lots more!

Was $299

NEW! 2004

A digital video camera for under $240!

Cat. QC-3230 $239.00

SAVE $60

'Norbert' Robotic Vacuum Cleaner

Sit back and relax while your robot cleans the house!

It automatically moves around obstacles, and an intelligent optical sensor assists in avoiding walls and obstructions. Works best to supplement your manual cleaner, not replace it.

Cat. GH-1395 Was $299

SAVE $50

Cat. GH-1395 $249.00

Spare Dust Filters Pk 2 Cat. GH-1396 $29.95

Mop Papers Pk 100 Cat. GH-1397 $24.95

Hot Stamping Pen Kit

Make your own Christmas cards!

Simply run the heat pen over the foil, and it transfers a metallic coating for a great effect. Supplied with pen, foil, and stencil.

Was $19.95

Cat. TM-3010 $14.95

SAVE $5

Extra Foil 5 Pack

Was $3.95

Cat. TM-3012 $2.95

SAVE $1

Multi-Function Torch Warning Light

Stay safe in emergencies!

Breakdowns & flat tyres at night can be dangerous and the more warning you can give other drivers of your presence, the safer you will be. It features a torch, flashing LED light, with a magnetic and tripod type base.

NEW! 2004

Cat. ST-3875 $39.95

SAVE $5

AM/FM Pocket Radio

Compact and portable!

An ideal gift for the older person who just wants to listen to races or sport.

Shirt pocket special!!

A large 1.5" speaker allows clear reproduction, and measures just 50(W) x 80(H) x 20(D)mm.

NEW! 2004

Cat. AR-1774 $9.95

4 in 1 Mars Rover, Boat & Submarine

This thing will go anywhere!

Whether it is driving over rough terrain, crossing water, or diving deep into it, this great craft will do it. It uses a skid steer drive system, or detach the wheels for full use of the props. Approx 180mm long.

NEW! 2004

Cat. GT-3420 $49.95

Galileo Thermometers

Invented by Galileo hundreds of years ago! These thermometers are as beautiful to look at as they are functional. The glass spheres rise and fall in the liquid column to indicate current room temperature.

Three sizes available:

GG-2100 28cm Was $29.95
GG-2102 38cm Was $49.95
GG-2104 53cm Was $79.95

STYLISH & FUNCTIONAL

Cat. GG-2100 $19.95 SAVE $10

Cat. GG-2102 $34.95 SAVE $15

Cat. GG-2104 $59.95 SAVE $20

Alcohol Breath Tester with Readout

Displays blood alcohol concentration between 0.00% and 0.1%! This great little unit helps keep the roads safe by providing a compact and portable blood alcohol indication. It provides a good result but should not be relied upon for precise results.

STAY SAFE THESE HOLIDAYS

Cat. QM-7292 $59.95

Go / No Go Alcohol Breath Tester

Simple indication!

Similar to the unit above. Instead of a LED scale, an LED lights at 0.05% blood alcohol and above.

Was $19.95

Cat. QM-7290 $14.95

SAVE $5

Theremin Synthesiser – Pre Built and Tested

NEW! 2004

As used in the Beach Boys' classic hit Good Vibrations!

The Theremin has an amazing range of notes from piercing shrieks to low-end growling sounds. Music shops sell Theremins for several hundred dollars, so you will be a bundle with Jaycar! This version is exactly the same as our kit version, except that it is fully built and tested, so you can start learning to play as soon as you get home!

Requires power supply

Cat. MP-3007 $17.50

Cat. AM-4025 $99.00

FOR INFORMATION AND ORDERING
TELEPHONE> 1800 022 888 INTERNET> www.jaycar.com.au

Notebook Docking Station

NEW! 2004

No more cable tangles!
Leave your peripherals connected to the dock, and just plug/unplug a single cable! Includes 4 port USB 2.0 hub, Ethernet, serial, and 2 x PS/2 connections.

Cat. XC-4860 **$139.00**

7 Port USB 2.0 Powered Hub

NEW! 2004

No more plugging and unplugging cables!
This high speed hub features powerand indiviual port LED indication. It is self powered, with a 5V/mains pluggpack included.

Cat. XC-4825 **$69.95**

USB to D9 RS-232 Converter

NEW! 2004

Ideal for laptops!
Many new notebook computers do not include a serial port. This device converts a USB port to a D9 serial connection so you can still use your serial devices.

Cat. XC-4834 **$39.00**

128MB 5 in 1 Digital Camera

NEW! 2004

Possibly the most versatile digital device around!
It measures just 72 x 17 x 15mm, but what you can't tell by looking at it, is that it actually has five different functions. It operates as a:

- 300k pixel digital camera storing up to 2000 images.
- 100k pixel digital video camera with up to 20 mins storage.
- Voice recorder with up to 2 hrs storage.
- Web camera when connected to a PC.
- 128MB USB flash disk for data storage.

Powered by an internal lithium battery charged by the USB port.
Was $299 Limited quantity

SAVE $50

Cat. QC-3224 **$249.00**

USB Powered Battery Charger

Recharge your batteries while you download your photos!
Why use another mains outlet when you can utilise the USB power at hand. Charge up to 4 x AA or AAA, Ni-MH or Ni-Cd batteries.

Cat. XC-4950 **$19.95**

NEW! 2004

USB Phone Charger / Mini Massager

No flat batteries, no sore muscles!
Charge your mobile phone from your USB port, or ease away the stress of the day. It suits Nokia, Siemens, Samsung, and Sony Ericsson phones.

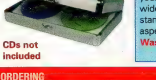
Cat. GG-2268 **$12.95**

NEW! 2004

Brushed Aluminium 64 CD Case

NEW! 2004

Strong and stylish!
Finished in brushed aluminium, it protects your CDs as well as looking great.



Cat. AR-1497 **$19.95**

CDs not included

USB Optical Mouse

Great rubber feel!
Ergonomic design, 500dpi resolution.

Cat. XH-5122 **$19.95**

NEW! 2004

Mini USB Optical Mouse with Retractable Lead

NEW! 2004

No more tangles!
The excess cord will retract out of the way.

Cat. XH-5124 **$29.95**

Wireless Keyboard & Mouse

NEW! 2004

Eliminate desktop clutter! Ergonomic design with a black and silver finish. Software supplied.

Cat. XC-5155 **$69.95**

Recordable DVD Spindles

NEW! 2004

Buy in bulk and save!

DVD-R 50Pk	**4x write speed**	**XC-4738**	**$39.95**
DVD+R 50Pk	**4x write speed**	**XC-4745**	**$39.95**
DVD-R 25Pk	**4x write speed**	**XC-4735**	**$29.50**
DVD+R 25Pk	**4x write speed**	**XC-4737**	**$29.50**

PC BASED VIDEO

USB 2.0 Video Capture Box

Streaming full resolution video on your PC!
Preview, record and playback video, or burn to CD or DVD. This is a great way of making DVDs if you own an analogue video camera. Includes capture and editing software, supports MPEG1 and MPEG 2.

Cat. QV-3090 **$99.00**

XPERT DVD Maker

NEW! 2004

Convert all your old VHS tapes and camcorder cassettes to DVD!
XPERT DVD Maker converts on the fly, so there is no need for excessive amounts of free disk space. All you need is a DVD burner and you can store your memories forever!

Cat. XC-4811 **$149.00**

High Definition Digital Terrestrial TV Card for PCs

HDTV on your computer!
Watch either high or standard definition TV on your PC! It supports wide-screen (16:9) and standard (4:3) aspect ratios.
Was $199

SAVE $20

Cat. XC-4819 **$179.00**

Business Card Scanner

NEW! 2004

No more data entry! Just slip a business card through the scanner, and it automatically detects the information, stores it in a database, or prepares it for export to popular software.

Cat. XC-4950 **$169.00**

Personal Paper & Media Shredder

Dispose of sensitive information for good!
Not only can you shred up to 15 pages at a time, it can also consume CDs, floppy disks, and credit cards with ease. Just pop them in and it's good- bye forever! A 15 litre bin takes care of the carnage.

Cat. YS-2830 **$129.95**

NEW! 2004

12 in 1 USB 2.0 Card Reader

Super fast data retrieval from your favourite media!
Supports most common media cards including XD.

Cat. XC-4853 **$59.95**

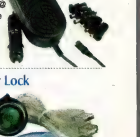
USB Radio and Remote Control

Radio on your PC!
Receive, play, and record FM radio stations through an ultra-stable phase-locked-loop (PLL) tuning system for superior reception. Includes an IR remote control which can also be used with software such as MS PowerPoint.

Cat. XC-4880 **$79.95**

Automotive Laptop Power Supply

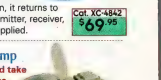
Includes plug for Dell laptops!
Power your laptop on the go from a 11 - 16VDC source. It can provide 15, 16, 18, 19, 20VDC @ 6A, or 22, 24VDC @ 5A. Lightweight switchmode design, 6 plugs included.



Cat. HP-3466 **$119.00**

USB Wireless Security Lock

Simple PC security!
Here is a neat and easy way to protect your PC from prying eyes and intrusive fingers. You keep a small transmitter with you, and when you are out of range (around 2m) it puts your PC into 'lock mode'. When you return, it returns to normal operation. Transmitter, receiver, software and drivers supplied.



Cat. XC-4842 **$69.95**

USB Magnifier Lamp

Utilise USB power and take the strain off your eyes.
A 50mm diameter glass lens provides great magnification while a built in lamp lights your work.

Cat. ST-2809 **$19.95**

Economy Car Alarm

Basic protection for your car! Includes black box controller, two transmitter keyfobs, shock sensor, ignition cut out relay, bonnet pin switch, siren, and wiring. **Was $119**

Cat. LA-9000 **$99.00**

SAVE $20

Full Feature Car Alarm

Extra security for peace of mind! Includes black box controller, two transmitter keyfobs, shock sensor, ignition cut out relay, bonnet pin switch, battery backup siren, and wiring. **Was $199**

SAVE $50

Cat. LA-9005 **$149.00**

Two Way Paging Car Alarm

Keep an eye on your car all the time! Includes black box controller, two transmitter keyfobs, foot brake trigger, car transmitter, shock sensor, ignition cut out relay, bonnet pin switch, battery backup siren, and wiring. **Was $349**

SAVE $50

Cat. LA-9010 **$299.00**

SHADOW Car Engine Immobiliser

Aus / NZ standards approved! It features all black wiring, so once installed, it will be a lot more difficult for anyone to hot-wire your car!

Cat. LA-8970 **$129.50**

Purchase the upgrade pack (LA-8975) which includes shock sensor, bonnet switch, and backup battery siren for just $40 more!

SAVE $39.50

Car Super Tweeter Bargain

Fantastic value! They have a frequency response of 6 to 20kHz and 40WRMS power handling.

Cat. CS-2218 **$5.00**

Or 2 for $8

7" Widescreen TFT LCD Monitors for Cars

See our website for full features & specs

Standard Mount 7" Monitor

Great versatility! It offers wide viewing angles, image reverse, and more!

Cat. OH-3752 **$399.00**

Headrest Bracket to Suit Great versatile mounting option.

Cat. OH-3757 **$14.95**

Roof Mount 7" Monitor

Ideal for rear seat viewing! It has integrated dome lights in the console, so you can replace your factory interior light.

Cat. OH-3751 **$419.00**

Dash Mount 7" Monitor

Retractable! This unit folds down to store into a single DIN space (standard car stereo space) so it will go unnoticed.

Cat. OH-3753 **$449.00**

6.5" Kevlar Split Speaker System

Great sound! The split system design allows optimum positioning of the tweeters for the best sound staging and imaging. 50WRMS power handling, 4 ohm impedance. See website for full details.

Cat. CS-2298 **$179 Pr**

Stereo FM Wireless Transmitter

Transmit the signals from your CD/MP3 player etc., to your car stereo! It has selectable channels that you tune into on your FM stereo. It is a cheap alternative to upgrading a car stereo, while still allowing new technology to be used. **Was $34.95**

Cat. AR-3110 **$29.95**

SAVE $5

Digital Tyre Pressure Gauge

NEW 2004

Stay safe on the roads! Incorrect tyre pressures can have adverse affects on handling and stopping distance. Keep check on your tyre pressures easily. 0 to 150PSI range.

Cat. GG-2310 **$19.95**

12VDC Ni-MH/Ni-Cd Fast Battery Charger

Super fast charging! Charges two or four batteries at once, suitable for AAA and AA cells. Automatic trickle charge and LED indication. **Was $34.95**

Cat. MB-3535 **$29.95**

SAVE $5

Mini Key Finder with Light

Don't lose your car keys! When this unit detects a whistle, it will beep, and alert you to its location. **Was $7.95**

Cat. XC-0350 **$5.95**

SAVE $2

2 x 150WRMS Car Amplifier

RESPONSE

Power to spare! It will provide ample power for you in-car audio installation. It will give you 2 x 150WRMS at 4 ohms, 2 x 230WRMS at 4 ohms, or a single channel of 450WRMS @ 4 ohms in bridged configuration.

Cat. AA-0434 **$289.00**

10" RESPONSE Metal Coated Cone Subwoofer

- 2 x 2 ohm voice coils.
- 250WRMS power handling.
- 87.2dB sensitivity.

Was $139

SAVE $20

Cat. CS-2366 **$119.00**

12" Double Magnet Subwoofer

RESPONSE

- 2 x 4 ohm voice coils.
- 250WRMS power handling.
- Up to 88.5dB sensitivity.

Was $279

SAVE $30

Cat. CS-2228 **$249.00**

2 x 84WRMS Car Amplifier

RESPONSE

- 2 x 84WRMS at 4 ohms.
- 1 x 234WRMS at 4 ohms bridged.
- High and line level inputs.

Was $199

SAVE $20

Cat. AA-0432 **$179.00**

4 x 50WRMS Car Amplifier

RESPONSE

- 4 x 50WRMS at 4 ohms.
- 2 x 150WRMS at 4 ohms bridged.
- High and line level inputs.

Was $219

SAVE $20

Cat. AA-0438 **$199.00**

8" Venom Double Magnet Subwoofer

- 100WRMS power handling.
- 4 ohm impedance.
- 88.35dB sensitivity.

Was $39.95

Cat. CS-2340 **$34.95**

SAVE $5

10" Venom Double Magnet Subwoofer

- 150WRMS power handling.
- 4 ohm impedance.
- 92.02dB sensitivity.

Was $64.95

SAVE $10

Cat. CS-2342 **$54.95**

12" Venom Double Magnet Subwoofer

- 180WRMS power handling.
- 4 ohm impedance.
- 87.85dB sensitivity.

Was $79.95

SAVE $15

Cat. CS-2344 **$64.95**

15" Venom Double Magnet Subwoofer

- 250WRMS power handling.
- 4 ohm impedance.
- 88.48dB sensitivity.

Was $99.95

SAVE $20

Cat. CS-2345 **$79.95**

UHF Phased Array TV Antenna

Digital TV ready!

- Band F IV/V, 470 to 862MHz.
- UHF Channels: 21 to 69
- Maximum gain: 12dB.
- Includes F type Balun.
- Used for horizontal or vertical polarisation.
- 470mm x 810mm.

Available in selected areas. Check your local store for availability.

NEW! 2004

Cat. LF-3158 **$64.95**

Image Media Player

Digital slide shows on your TV!

Just insert your memory card and plug it into the composite input on your TV! It also acts as a card reader when connected to your PC.

NEW! 2004

Cat. XC-4857 **$149.00**

Tie Clasp Microphone with Power Supply

No need for extra power!

Electret condenser type microphones require power to operate. A small battery supply in the supplied adaptor takes care of this.

NEW! 2004

Cat. AM-4093 **$29.95**

Secure Clip-On Earphones

Won't fall out when you're jogging! They are comfortable to wear, sound great and will give you hi-fi performance from the Neodymium speakers. 3.5mm stereo plug.

Cat. AA-2023 **$12.95**

NEW! 2004

7 Metre Retractable Coaxial Lead

No more tangles!

The cable retracts into the holder when not in use. Includes gender change adaptor.

NEW! 2004

Cat. WV-7368 **$14.95**

UHF Wireless Stereo Headphones

No more limitations!

Walk freely around your home listening to your favourite tunes. Up to 100m range. Use internal rechargeable batteries.

Cat. AA-2000 **$89.00**

Was $109

SAVE $20

VHS Head and DVD / CD Lens Cleaners

Keep it clean! If you experience problems with playback, distortion in the audio, or DVD skipping etc., it is quite possible that it is simply dirt causing the problem. These cleaners will take care of that, and get you the picture quality you want. See website for details.

NEW! 2004

DVD Lens Cleaner with Voice Guide

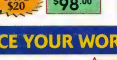
Cat. AR-1410 $14.95

VHS Head Cleaner with Solution

Cat. AR-1412 $9.95

CD / DVD Lens Cleaner

Cat. AR-1416 $19.95



Radial CD / DVD Disc Cleaner

Cat. AR-1414 $17.95

Scart Plug to RGB Video Adaptor

Simple, but effective!

Scart plug to 3 x RCA sockets, bi-directional.

NEW! 2004

Cat. PA-3667 **$12.95**

50WRMS Faders (L-Pads)

Independent volume control!

Mount them in the speaker cabinets or wall. Constant impedance design, 50WRMS rated.

Mono Cat. AC-1672 **Was $19.95** Cat. AC-1672 **$14.95** SAVE $5

Stereo Cat. AC-1673 **Was $31** Cat. AC-1673 **$24.00** SAVE $7

3 Input Remote Control A/V Selectors

Run out of inputs?

A great solution to the problem, and cover most common connections. See website for details.

Composite Version Cat. AC-1674 **Was $148.95** Cat. AC-1674 **$128.95** SAVE $20

RGB Version Cat. AC-1676 **Was $149** Cat. AC-1676 **$129.00** SAVE $20

3 Piece Surround Sound Add-On

Enjoy the surround sound experience.

The centre speaker contains a screened 4" mid/woofer, and 2" tweeter with a 6 ohm impedance. The two rear speakers contain a 4" full range with a 4 ohm impedance.

2004 Cat Price $99.95 SAVE $30

Cat. CS-2465 **$69.95**

15dB RF Amplifier

Boost your signal for better picture!

It has F type input/output connectors, variable gain and mounted into a rugged die-cast aluminium enclosure.

Was $118

SAVE $20

Cat. LF-3242 **$98.00**

4 Way Optical Switch Box

Simple solution!

Optical signals cannot be electronically switched, but this switch box provides a solution. Four inputs (1 x 3.5mm, 3 x Toslink), 1 Toslink output.

Cat. AC-1875 **$19.95**

12" 150WRMS Powered Subwoofer

Add a new dimension to your home theatre! It uses a well designed bass reflex enclosure for the best performance. Measures 375(W) x 510(H) x 410(D)mm.

Was $459

Cat. CS-2456 **$399.00** SAVE $60

REPLACE YOUR WORN OUT SPEAKERS AND ENJOY A BETTER SOUND!

Vifa D26 Screened Tweaker

- 100WRMS system power handling.
- 3 to 22kHz frequency range.
- 91dB sensitivity.

Was $39.95

SAVE $10

Cat. CT-2022 **$29.95**

RESPONSE Dome Tweeter

- 200WRMS system power handling.
- 1.5 to 20kHz frequency range.
- 94dB sensitivity.

Was $22.95

SAVE $5

Cat. CT-2010 **$17.95**

4" Magnetically Screened Woofer

- 200WRMS power handling.
- 70Hz to 10kHz frequency range.
- 84dB sensitivity.

Was $24.95

SAVE $5

Cat. CW-2104 **$19.95**

6" High Power Polycone Woofer

- 80WRMS power handling.
- 39Hz to 3kHz frequency range.
- 87dB sensitivity.

Was $59.95

Cat. CW-2135 **$49.95** SAVE $10

8" High Power Polycone Woofer

- 120WRMS power handling.
- 39Hz to 3.5kHz frequency range.
- 90dB sensitivity.

Was $74.95

Cat. CW-2134 **$59.95** SAVE $15

10" High Power Polycone Woofer

- 160WRMS power handling.
- 29Hz to 2.5kHz frequency range.
- 91dB sensitivity.

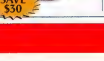
Was $99

Cat. CW-2137 **$79.00** SAVE $20

12" Carbon Fibre Woofer

- 200WRMS power handling.
- 25 to 3.5kHz
- 93dB sensitivity.

Was $149.95



Cat. CW-2145 **$119.95** SAVE $30

2" Widerange Speaker

- 280Hz to 10kHz frequency range.
- 103dB sensitivity.

Was $3.95

Cat. AS-3020 **$2.95** SAVE $1

Wide Angle 4x Binoculars

NEW! 2004

Wide 16° angle viewing!
Great for a day at the races, or simply enjoying a view. Weighs just 167g.

Cat. GG-2126
$29.95

Wind Up Dynamo LED Torch

NEW! 2004

A great backup torch!
Wind the handle for about a minute, and you get about 30 minutes of superbright light. Selectable 1 or 3 LED operation, water resistant.

Cat. ST-3337
$29.95

Super Bright Luxeon LED Torches

Massive light output!
Luxeon LEDs are some of the brightest in the world, and these torches are blinding. Check out our website for details and specs.

ST-3333 - 1 Watt

ST-3334 - 3 Watt

Cat. ST-3333
$59.95

Cat. ST-3334
$89.95

8 Litre Collapsible Bucket

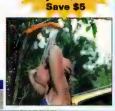
No need for wasted storage space! This bucket collapses down to just 255 x 35mm when not in use. Measures 255 x 230mm open with an 8 litre capacity.

Cat. GH-1260
$14.95

Buy a collapsible bucket and camping shower for just $29.90 Save $5

12V Camping Shower

Wash away the cares of the day - no matter how far from civilisation you are!
The camping shower allows you to take a shower wherever you are. Powered by your vehicle's 12V battery.



Cat. YS-2800
$19.95

Handy Plastic Sealer

Ideal for picnics and camping trips!
It heats up in seconds to form a seal on plastic bags. Great for sealing up lunches and food.
Was $12.95

SAVE $3

Cat. GH-1320
$9.95

Mini Waterproof Camping Lantern

Floats if dropped in water!
It is completely waterproof, and stands about 160mm tall.
Was $12.95

SAVE $3

Cat. ST-3333
$9.95

16 in 1 Stainless Steel Multi Tool

Rugged and versatile!
Wire cutters, file, saw, scissors, bottle opener, can opener, knives, screwdrivers, and more!
Was $29.95

SAVE $5

Cat. TH-1603
$24.95

LED Map Reading Light

Don't get lost in the dark!
Great for map reading in the dark, it features a 300mm adjustable gooseneck and cigarette lighter plug.
Was $9.95

SAVE $2

Cat. ST-3059
$7.95

40Ch UHF CB Transceiver Wrist Watch

NEW! 2004

Full function in a wrist watch!
They are extremely portable, and use internal rechargeable batteries. Up to 2km range.

Cat. DC-1070
$199PR

40 Channel UHF Transceiver with CTCSS

Cut out CB traffic noise!
It remains silent until 'called' from another CTCSS equipped transceiver. Up to 5km range
Was $79.95

SAVE $20

Cat. DC-1030
$59.95

1.5W High Powered UHF CB Band Transceiver

Massive range!
Up to 8km working range with a hi/lo setting to conserve power.
Was $119

SAVE $20

Cat. DC-1040
$99.00

12VDC Cooler / Warmers

Keep your pies hot, or your beers cold!
A solid state thermoelectric device cools to -25°C, or heats to +65°C relative to ambient temperature. They are a reliable and portable way to transport hot or cold food and drinks over long distances without trouble. They are powered from your car's cigarette lighter socket or a mains plugpack.

4L RED Cat. GH-1376
4L SILVER Cat. GH-1377
Holds 6 x 375mL cans
$44.95

4L Versions (ea)

8L RED Cat. GH-1378
Holds 12 x 375mL cans
$79.95

8 Litre Version

High Power Rechargeable Halogen Spotlights

You will need sunglasses for these babies!
High power Quartz Halogen globes are fed power from the internal sealed lead acid batteries. They're extremely bright, with beams that can be seen for kilometres! They include car and mains chargers.

1,000,000 Candle Power
Cat. ST-3300 Was $34.95 Save $5

2,000,000 Candle Power
Cat. ST-3302 Was $49.95 Save $10

3,500,000 Candle Power
Cat. ST-3304 Was $69.95 Save $10

Cat. ST-3300
$29.95

Cat. ST-3302
$39.95

Cat. ST-3304
$59.95

Get into Health & Fitness to get fit for Summer

Digital Watch with Pulse and Energy Consumption Function

Even calculates calories burnt!
Get fit for summer!
Was $39.95

SAVE $10

Cat. XC-0265
$29.95

Laptech Personal Swim Timer

Just like your own swim coach!
It mounts above or below the water, just touch the face each lap.

Cat. XC-0210
$59.95

Hygienic Electronic Whistle

All the noise without the spit!
Just press the button for a loud 120dB whistle sound. Great for personal safety and sporting events.

Cat. YS-2812
$19.95

Hand Held Body Fat Analyser

Calculates your body fat content!
You could measure your reducing waist line, but this analyser actually calculates your body fat content. Very accurate.
2004 Cat Price $29.95

SAVE $15

Cat. QM-7252
$14.95

Sports Stopwatch

Compact and accurate!
Accurate to 1/100th of a second with lap and split time functions. Includes lanyard.

Cat. XC-0270
$9.95

Pedometer with FM Radio

Listen to music while you burn calories!
It features an auto scanning FM radio with earphones.
Was $19.95

SAVE $5

Cat. XC-0264
$14.95

3kg Digital Nutrition Scales

Do you know what is in your food?
Calculates the nutrition value based on weight.
Was $79.95

SAVE $10

Cat. QM-7240
$69.95

Electronic Body Fat Scales

How much body fat are you carrying? They work as scales, and also calculate your body fat content.

Cat. QM-7249
$129.95

FOR INFORMATION AND ORDERING:
TELEPHONE> 1800 022 888 INTERNET> www.jaycar.com.au

Small Scrolling Message Board

Compact and versatile!
It displays four characters at once, with programmable messages up to 60 characters in length. 110 x 50mm display area. **Was $59.95**

Cat. XC-0190 **$44.95** SAVE $15

Medium Scrolling Message Board

Integrated keyboard!
You can enter a message up to 60 characters long, or use one of the 26 stored messages. Overall size is 450(L) x 230(H)mm.
Was $109.95

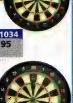
Cat. XC-0192 **$89.95** SAVE $20

Large Scrolling Message Board

Huge 60mm high characters!
Displays 12 characters at a time. 60 character message length, 26 stored messages. Overall size is 750(W) x 300(H)mm.

Cat. XC-0194 **$149.00**

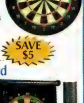
Tabletop Magnetic Dartboard



No mounting required!
Just sit it on your desktop and away you go! Measures 270mm diameter. **Was $14.95**

SAVE $5 Cat. GH-1034 **$9.95**

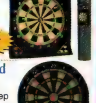
Wall Mount Magnetic Dartboard



Safety first! It uses safe magnetic darts, so it is safe for kids, and for playing inside the house. Measures 430mm diameter. **Was $24.95**

Cat. GH-1036 **$19.95** SAVE $5

Roll-Up Magnetic Dartboard



Great portability!
Take it wherever you go for a quick game. Just roll it out and hang it up! 435(L) x 375(W)mm.
Was $29.95

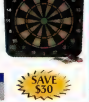
Cat. GH-1037 **$19.95** SAVE $10

Mini Electronic Dartboard

Automatic scoring! It features sound effects and scoring to keep your game of darts exciting. Up to four players, measures 275(H) x 210(W) x 40(D)mm.
Was $29.95

Cat. GH-1038 **$24.95** SAVE $5

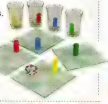
Electronic Talking Dartboard



The ultimate dart game!
Complete with talking sound effects and automated scoring, you can have an exciting game of darts even by yourself!
Was $99.95

Cat. GH-1030 **$69.95** SAVE $30

Snakes and Ladders Drinking Game



Just like regular snakes and ladders, but with an alcoholic twist! Challenge up to 3 people and see who can overcome the shot-traps and snakes to reach the top of the ladder. Includes 1 x dice, 4 x shot glasses and 4 x glass coasters.

NEW! 2004

Cat. GT-3008 **$19.95**

Electronic Candles

Look just like tea candles!
There is no messy wax or danger, they provide safe, intimate illumination. Powered by internal rechargeable batteries, includes charger. See website for extra candles.
Was $29.95

SAVE $5 Cat. SL3922 **$24.95**

Oblique-Spheroid Hematite Magnets

Throw them in the air and see what happens! Do all the normal tricks you can do with magnets, but these little beauties come into their own when you make them stand on their end or spin around making a chirping 'glissando' sound. Ask in store for a look!

NEW! 2004

Cat. LM-1650 **$14.95**

Anti-Fog Shaving Mirror with FM Radio

Shave in the shower and save time!
It won't fog up, and it tunes into your favourite station too.
Was $29.95

SAVE $5 Cat. GH-1059 **$24.95**

Aromatherapy Table Lamp

Soothing and relaxing!
Relaxing aromas will fill your room without the danger of candles. Lavender, sandalwood, and lemongrass supplied. Mains powered.
Was $39.95

Cat. GH-1045 **$29.95** SAVE $10

EXCALIBUR ELECTRONIC GAMING PRODUCTS

We have found a great new range of products designed in the USA. They are of excellent quality, just drop into your local store for a look!

Electronic Touch Screen Chess and Checkers

Pocket sized entertainment! You can play against the computer, or even use it as a 'chess trainer', with the computer suggesting the next best move. It also offers a great game of checkers.

NEW! 2004

Cat. GT-3512 **$79.95**

Two in One Chess Computer

Great gaming options! Use the unit handheld on its own, or plug it into the unique Excalibur game board for a real electronic game. The computer can offer hints on moves, and more!

Cat. GT-3510 **$69.95** NEW! 2004

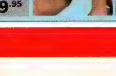
"Ivan the Conqueror" Talking Chess Board

Ordinary chess, evolved into an exciting battle! The intelligent computer can suggest moves, tell you which of your pieces are under attack, and more! Great sound effects add extra life to the game too.

NEW! 2004

Cat. GT-3514 **$149.95**

Handheld Electronic Pool



No need to go to the pub! You can choose from a game of 8 ball, or traditional pool. It uses a 'virtual cue' to give you control, with a pool table simulated on the screen. Great fun!

NEW! 2004

Cat. GT-3500 **$29.95**

Electronic Quiz Master

Strain your brain! Over 2200 challenging questions covering 200 different topics. Questions are randomly selected, and it caters for up to 4 players. It is great fun, and is sure to keep you entertained.

NEW! 2004

Cat. GE-4230 **$49.95**

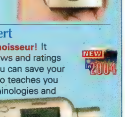
New York Times Electronic Crossword Puzzle

Hours of fun! Over 1000 crosswords taken from the New York Times newspaper. They are sorted into three levels of difficulty, and is all operated through the touch screen interface.

NEW! 2004

Cat. GE-4232 **$119.95**

Electronic Bar Master



Mix every drink to perfection! Designed to look like a hip-flask, this great gadget stores over 1000 drink recipes so you can mix up a storm. It also includes sample toasts for every occasion, and even bar jokes.

NEW! 2004

Cat. GE-4212 **$49.95**

Electronic Wine Expert

The electronic wine connoisseur! It contains over 10,000 reviews and ratings from wine experts, and you can save your own information too. It also teaches you wine basics including terminologies and descriptions.

NEW! 2004

Cat. GE-4210 **$49.95**

Novelty Boss Voodoo Doll

Show your boss what you really think! Twist his arms, break his legs, and he will be begging for you to come back to work with a pay rise. Great fun for every one.

Cat. GT-3104 **$24.95**

Novelty Animated "Fat Bastard" Doll

A must for Austin Powers fans! The Scottish-accented, repulsive character from the movie is a barrel of laughs. He will belch, fart, or say one of eight hilarious phrases.

Cat. GT-3106 **$29.95**

Novelty Animated Farting Man

Endless fun for practical jokers! He turns his head and lets out farting noises when someone passes by. Stands 250mm tall.

Was $24.95 Cat. GT-3100 **$19.95** SAVE $5

Novelty Animated Flashing Man

For the practical joker's bar! He looks around, then opens it coat and drops his pants to the tune of Beethoven's 5th symphony, then Stevie Wonder's Superstition.

Was $24.95 Cat. GT-3102 **$19.95** SAVE $5

Electronic Toy Safes

Ideal protection against... siblings! Features an illuminated keypad and programmable combination, with voice or sound effects. Measures 185(H) x 135(W) x 125(D)mm.

Pink Cat. GH1310 **Blue** Cat. GH1311

All Colours (ea) **$19.95**

Radio Controlled Submarines

Great underwater fun! They have full manoeuvrability with forward, reverse, left and right, and a power dive function. Two types available:

27MHz Yellow Cat. GT-3044
40MHz Blue Cat. GT-3045

Was $29.95

SAVE $5

Both types **$24.95ea**

Radio Controlled Clown Fish

Swims underwater! It has full manoeuvrability with forward, reverse, left and right, and a power dive function. Great fun.

Cat. GT-3225 **$29.95**

Remote Controlled Flying Saucer

Soar to new heights of excitement! This untethered flying saucer will soar into the air, while you maintain full control over its height. A small internal battery can be recharged on the landing base. Saucer dia. is 230mm.

Cat. GT-3004 **$49.95**

Super Bright LED Keyring Torches

Never be without a torch! They are bright enough to help find keys and keyholes, or assist with personal safety. Measure 45L x 32W x 15Dmm.

Red Cat. ST-3044 **Blue** Cat. ST-3047
White Cat. ST-3048 **UV** Cat. ST-3043

Cat. ST-3044/47/48 **$6.95 each**

Was $7.95 SAVE $1

Cat. ST-3043 **$7.95**

Was $9.95 SAVE $2

Keyring Laser Pointer

Bright, long distance beam. Ideal for lecturers, or just for fun, it features a 1mW laser module with a chrome finished housing. Measures 73(L) x 15(dia)mm.

Was $12.95

SAVE $5

Cat. ST-3102 **$9.95**

Radio Controlled Boat

Great fun on the water! This little beauty speeds around the bathtub or pool with full manoeuvrability. Uses an internal battery that is recharged with the battery pack.

Cat. GT-3410 **$29.95**

Farting Salt n Pepper Shakers

A great gag for all occasions. They make a fart sound when tipped upside down. Great for parties!

Cat. GH-1090 **$19.95**

Hand Held Farting Keyring

Every practical joker should have one! Makes a great farting sound when the button is pressed.

Cat. GH-1082 **$9.95**

Remote Controlled Secret Farter

The new millennium's whoopee cushion! Activated by a remote control, it has three realistic fart sounds.

Cat. GH-1088 **$19.95**

Self Frothing Coffee Mug

Instant frothy milk! Just pour it in and hit the button. Can also be used to stir milk and sugar into regular tea and coffee.

Was $19.95 Cat. GH-1300 **$14.95** SAVE $5

Battery Operated Pepper Mill

No wrist action required! Just touch the button on the top and it delivers streams of fresh pepper. An LED lights your food for application too.

Cat. KY-5521 **$24.95** SAVE $5

STAY ON TIME WITH OUR GREAT RANGE OF CLOCKS!

Alarm Clock with Laser Time Projection

Projects the time on your wall or ceiling! It includes an LCD for constant display, and projects the time when you touch the button or the alarm goes off

Cat. XC-0218 **$39.95**

LCD Desk Clock with Thermometer

Stylish and functional! It has a great EL blue backlight, as well as calendar and temperature display. Measures 117(H) x 90(W) x 62(D)mm.

Was $34.95 Cat. XC-0226 **$29.95** SAVE $5

Basketball Action Clock

For every basketball fan! Throw it at the wall to turn the alarm off! You can't play ball with it, but it is fun to wake up to. 100mm diameter

Was $14.95 Cat. XC-0159 **$9.95** SAVE $5

Wireless Doorbell with Clock and Thermometer

Huge 30m range! Its main function is a doorbell, but the main unit also houses a large LCD clock with calendar and indoor/outdoor temperature.

Was $54.95 Cat. XC-0250 **$44.95** SAVE $10

Desk Clock with Alarm and Calendar

Small, sleek, and stylish. A unique rubber stand moulds to any shape to suit all surfaces. Clock face size is 81(H) x 55(W)mm.

Cat. XC-0216 **$17.95**

Mini Talking Alarm Clock

Looks great, works well! It has a protective cover that doubles as a desk stand, making it ideal for travel. Just press the button and it announces the time!

Was $14.95 Cat. XC-0238 **$9.95** SAVE $5

Soccer Alarm Clock

Attention soccer fanatics! This is one alarm you won't sleep through. It plays 'ole ole ole' when the alarm goes off!

Was $24.95 Cat. XC-0246 **$19.95** SAVE $5

Automatic IR Remote Control Alarm Clock

The alarm goes off and turns your TV on! It sounds an alarm to wake you up too, with a bright blue backlit screen making reading easy.

Cat. AR-1732 **$29.95**

FOR INFORMATION AND ORDERING
TELEPHONE> 1800 022 888 INTERNET> www.jaycar.com.au

Animated Pen Stand

HILLARIOUS!

Your Grandmother won't like it, but you will!
It lets out a series of amusing sounds and lifts its head when you insert a pen into the rear-facing rectal receptacle.

Cat. GT-3110
$19.95

1000 Foot Air Rocket and Launcher Set

The sky is the limit! This air powered launcher uses a compressed air based propulsion system to launch the rockets high in the sky. It uses any heavy duty foot pump, or a 12V car pump which is (not included but commonly available). Limited qty.
2004 CAT PRICE $59.95

Cat. GT-3000
$29.95
SAVE $30

Novelty DJ Scratch Effects Box

Be the master of the turntable!
Well, not exactly, but at least have some fun. It plays one of three tunes, and you turn the disc for a 'scratch' effect creating your own musical masterpiece.
•Measures approx. 75 x 65mm.

Cat. GT-3275
$9.95

RF Wireless Weather Station

You can't make it rain, but find out when it will!
It predicts the weather based on current data, and displays the temp, humidity, time, and date.
Was $99

Cat. XC-0295
$79.00
SAVE $20

Personal Desktop Fan

Keep your cool in summer!
It will create a refreshing breeze to keep you cool. Measures 130(W) x 160(D) x 75(H) folded.
Was $12.95

Cat. GH-1074
$9.95
SAVE $3

Personal Air Humidifier / Conditioner

Great on hot or dry days!
It acts as a humidifier for those dry days, or it can blow cool air on hot days! 12VDC powered.
Was $29.95

Cat. YS-2810
$24.95
SAVE $5

Personal Fans with Water Spray

Keep your cool!
These fans heve a water spray to use on those scorching summer days.
Small size GH-1070 Was $3.95
Large size GH-1072 Was $7.95

Cat. GH-1070
$2.95
SAVE $1

Cat. GH-1072
$4.95
SAVE $3

Reach Extender / Pickup Tool

The ultimate couch potato tool!
Extend your reach almost 1 metre! Lightweight aluminium construction, suction cup ends, and a pistol grip. **Was $14.95**

Cat. TH-1844
$12.95
SAVE $2

Infrared Remote Control Jammer

Strike back at remote control hogs!
It jams the signals of most infrared remote controls, rendering them temporarily useless!

Cat. GH-1084
$9.95

8 Language Pocket Translator

Travelling overseas?
It translates to and from English, French, German, Spanish, Italian, Dutch, Portuguese, and Turkish. Also includes personal organiser features. **Was $24.95**

Cat. XC-0180
$19.95
SAVE $5

100k Mini Digital Camera

Pocket sized at just 60 x 43 x 17mm, with a maximum capacity of 80 photos.

Cat. QC-3190
$29.95

300k Mini Digital Camera

Compact and lightweight at just 41g, with a maximum capacity of 208 photos. Measures 65 x 53 x 21mm.

Cat. QC-3192
$49.95

Binoculars with 300k Digital Camera

Fantastic 8x magnification binoculars, with an integrated camera to take photographs from a distance. Up to 100 seconds of video can also be recorded. Measures 110 x 90 x 46mm. **Was $74.95**

Cat. QC-3198
$64.95
SAVE $10

Fishing Tool Set

A must have for every recreational fisherman!
It includes a 14 in 1 multi tool, 0 - 6kg scales, and an LED hand torch, all in a convenient belt pouch.

Cat. TD-2053
$29.95

Electronic Aeroplane Skywriter

Great at parties, special events or sporting event.
Just spin the airplane around in a circle and a message will appear in mid-air before your very eyes! The skywriter has 15 preset messages and you can also program a message of your own. Suitable for ages 5 and up. **Was $29.95**

Cat. XC-0196
$10.00
SAVE $19.95

Vibrating Head and Joint Massager

Relax!
It has a soothing vibration with attachments for use on the head or joints. Great after a hard day at work.
Was $19.95

Cat. GG-2260
$14.95
SAVE $5

Glow Sticks

Great low price!
They produce a soft glow for up to eight hours. Great for dance clubs and parties!
Size 150(L) x 18(Dia)mm.
ST-3160 Red ST-3161 Yellow
ST-3162 White ST-3163 Blue
ST-3164 Pink

ALL COLOURS
$2.50 ea
or 5 for $10

3 in 1 Party Pack

A party in a box! Just add friends! It contains a mains powered strobe light, 100mm diameter mirror ball with stand, and battery powered UV blacklight.

Cat. SL-2979
$69.95
SAVE $10

Mini Strobe Light

Great for parties!
Feature a variable flash rate up to 10Hz, and is mains powered. Uses a Xenon flash tube, and measures 85(W) x 50(H) x 125(D)mm.
Was $29.95

Cat. SL-2990
$24.95
SAVE $5

UV Cool Tubes

Dazzling effects!
They are actually UV reacting tubes that glow under blacklights. Supplied with orange, blue, green , and pink tubes, each 1.5m long, with shaping wire, clips and joiners.
Was $12.95

SAVE $3

Cat. SL-3180
$9.95

12VDC Mini PAR Halogen Light

Just like a real PAR can light, but smaller! It houses an MR11 halogen lamp. Supplied with mains plugpack and coloured filters.
Was $29.95

Cat. SL-2967
$24.95
SAVE $5

12" Blacklight UV Neon Tube

Just like a blacklight at nightclubs!
It creates a great effect in your car or home. Requires 12VDC @ 250mA.
Was $22.95

Cat. ST-3147
$17.95
SAVE $5

12" Lightning Blue Neon Tube

Lightning in a tube!
It creates a continuous flow of twisting and spiralling light through the tube. Requires 12VDC @ 450mA.
Was $29.95

Cat. ST-3148
$24.95
SAVE $5

AV-GAD 8 Sector Alarm with Dialler Deal

A tried and tested system!

When reliability is of the utmost importance, AV-GAD alarms will deliver. Check out our website for the long list of great features.

SAVE $200

LIMITED QUANTITY

Kit includes:

- 8 sector panel.
- 2 x reed/magnet sets.
- 7Ah SLA backup battery.
- 1 x horn speaker.
- Mains power supply.
- 1 x internal siren.
- 200m of 6 core ACA approved alarm cable.
- 5 AV-GAD PIRs.
- Standard keypad.
- 1 x strobe.
- 6 x deterrent speakers.
- 1 x ABS siren cover.
- 30m roll of 2 core cable.

Cat. LA-5485 **$699.00**

Was $899

Economic Two Zone Alarm Controller

Simple security!

Ideal for boats, caravans, granny flats etc., if features instant and delayed zones, with 2 x 8 ohm horn outputs, and a N/O relay output. Ltd qty.

Cat. LA-5590 **$19.00**

Was $29.95

SAVE $10.95

Melcom 5 Sector Alarm with Built-In LCD Keypad Installer Kit

NEW! 2004

All new from Melcom!

The LCD keypad and brains have been combined to make a compact alarm system for easier installation. It offers a number of advanced features including a two line 16 character LCD display, and a dictionary of 84 location names that can be assigned to each sector. See website for all the details.

Installer kit includes:

- 1 x Melcom Alarm Panel with built-in LCD Keypad
- 1 x Power supply
- 1 x 1.2Ah SLA Battery
- 2 x Micron pulse count PIR's
- 2 x N/O Reed/magnet assemblies
- 1 x Siren horn
- 1 x Strobe light
- 1 x Siren cover
- 2 x 30mt 4-core cable
- 4 x Large Alarm Stickers

Cat. LA-5435 **$369.00**

Self Contained Security Keypad

Over 100 million possible combinations.

Great for a simple secure setup for a door entry or similar. Single relay output.

SAVE $12

Cat. LA-5555 **$54.95**

Was $66.95

Dual Relay Remote Controlled Switch

Wireless control!

Add wireless operation to garage doors, gates, lights, just about anything that switches on and off! Two relay outputs, one latching, and one momentary.

Was $129.95

Cat. LR-8825 **$109.95**

SAVE $20

Commercial Grade Door Entry Beam

NEW! 2004

Ideal for use in retail and commercial environments.

It has an effective range of 2 - 8 metres, so it is suitable for most entry points. Includes mains plugpack.

Cat. LA-5193 **$119.00**

Counter to Suit Door Entry Beams

Obtain door count data in retail environments!

Counts up to 9999 and is suitable for use with LA-5193/96 entry beams.

NEW! 2004

Cat. LA-5197 **$69.95**

Wireless Doorbell / Intercom with Door Strike Release

NEW! 2004

Open the door from anywhere! This great unit acts as an intercom, with a wireless receiver. Take it out the back, or around the house. It also has electronic door strike control, so you can let your visitors in too!

Cat. AI-5510 **$129.00**

2.4GHz Portable Video Baby Monitor / Wireless Monitoring System

NEW! 2004

Keep more than an ear out for your sleeping baby.

Why not keep an eye on them as well? An integrated 45mm LCD allows you to see and hear your child. Camera features 8 IR LEDs for 'night vision', so you don't even need a light on. The applications of this system don't stop there however; you could use it for any remote monitoring application! Up to 3 cameras can be used with the receiver.

Was $299

Cat. QC-3280 **$259.00**

SAVE $40

Extra cameras also available

Cat. QC-3281 Only $189.00

Installing a Home Alarm / Security System Book

Get it right the first time! If you are looking to purchase and install an alarm for the first time, this guide it essential reading. 8 pages, A4.

Cat. BI-6205 **$2.00**

FREE With Any Security Product Purchase Over $20 (but you must ask!)

6 Core Approved Alarm Cable 100m Roll

Australian made!

Austel approved for use on alarm systems with dialler outputs. 6 x 7 / 0.2 flexible stranded conductors.

Was $1.35/m

SAVE 45c/m

Cat. WB-1598 **$67.00**

Electric Door Strike

Unlock your door at the touch of a button!

It requires a 12VAC/DC @ 800mA pulse, and will work with the existing lockset.

Was $48.95

SAVE $10

Cat. LA-5078 **$39.95**

RFID – Secure Access Without Keys!

Radio Frequency Identity (RFID) is a contact-less method of controlling an event such as a door strike or alarm etc. An 'RFID Tag' transmits a unique code when energised by the receiver's magnetic field. As long as a pre-programmed tag is recognised by the receiver, access is granted.

RFID Security Module Receiver Kit

Ref: Silicon Chip June 2004. Provides normally open, normally closed electrically switched outputs. Supplied PCB will mount behind standard wall plate. Kit supplied with PCB, tag, and all electronic components.

Cat. KC-5393 **$89.95**

Includes 1 Keyfob RFID tag worth $9.95 absolutely FREE! See below for extra tags.

EXCLUSIVE: The Jaycar kit includes a specially modified PCB that is designed to fit within an Aust/NZ standard Clipsal / HPM type wall plate. Beware of inferior kits that do not have this valuable feature. This is in addition to the high quality parts like machined pin IC sockets, silk screened PCB and more that may not be included in our competitors kits.

RFID Tags

These tags transmit a 40 bit unique code and are EM-4001 compliant. Three styles available:

Keyfob Style
Cat. ZZ-8950 **$9.95**

Credit Card Style
Cat. ZZ-8952 **$5.95**

Clear Style - NEW
Cat. ZZ-8954 **$4.95**

Wedge Shaped Doorstep Alarm

Simple Security! Just place it behind the door you want to monitor, and when someone tries to open it, an alarm will sound! Limited quantity.

Was $14.95

SAVE $5.95

Cat. LA-5012 **$9.00**

SAVE ON PASSIVE INFRARED DETECTORS

Micron Pulse Count PIR

Normally open contacts!

Uses a proven design for a high level of performance and stability.

Cat. LA-5035 Was $39.95
Now $24.95 Save $15

Proton Quad Pulse Count PIR

Designed in the UK! Uses a unique four element sensor, which enables it to detect in three dimensions!

Cat. LA-5025 Was $39.95 Now $29.95 Save $10

PIR Lenses!

Pet Alley lens to suit LA-5025	Cat. LA-5027
Curtain lens to suit LA-5025/30	Cat. LA-5032
Long Range lens to suit LA-5030	Cat. LA-5031
All types (ea) Was $5.60 Now $2 Save $3.60	

Twin Photo Beam Detector Transmitter / Receiver

Up to 60m indoor range!

It actually uses two beams to assist in eliminating false triggering from birds, leaves etc. Normally open and normally closed relay contacts are provided, while the cases are weatherproof, and sunlight filtering to avoid interference.

Was $199

Cat. LA-5196 **$159.00**

SAVE $40

FOR INFORMATION AND ORDERING:
TELEPHONE> 1800 022 888 INTERNET> www.jaycar.com.au

Desktop B&W Video Doorphone

Keep an eye on the door while sitting at your desk!

Its functions are similar to our popular wall mount versions, with a 5.5" monitor and slimline handset and electric door strike control. The outdoor unit houses a quality 380TV line CCD sensor with six infrared LEDs for night illumination. See website for full details.

Cat. QC-3620 **$129**

4 Channel Multiplexing DVR with Audio and 120GB HDD

Top quality multiplexing operation without the expense!

It offers four video channels each with audio, switching or multiplexed display, and advanced features such as picture zoom and motion detection recording. See website for details.

Cat. QV-3069 **$999**

16 Channel DVR with Audio and 120GB HDD

The ultimate in digital surveillance recording!

Don't be caught with difficulties trying to integrate multiplexers and recorders. This unit does it all in one, with seamless multiplexing and recording right down to one frame per second. See our website for a massive list of features! **Was $1,599**

SAVE $100

Cat. QV-3068 **$1499**

18 LED IR Spotlight for Cameras

Use a surveillance camera in 0 Lux conditions!

It has a waterproof metal case with an effective range of around 5 metres. Requires 12VDC @ 200mA.

•44.5(Dia) x 27(D)mm.

Cat. QC-3650 **$69.00**

Vandal Resistant Dome Camera Housing

Built like a tank!

No matter how sophisticated your surveillance system is, there is always the possibility of it being destroyed. This housing can withstand more than 500kg of pressure, and a blow from a 4.5kg sledge hammer. Suits standard board cameras.

Cat. QC-3328 **$39.95**

B&W Video Doorphone

See who's at your door before you let them in!

The 4" screen lets you see your visitors, and you can talk to them through the handset. Supplied with all mounting hardware and wiring.

Was $199 SAVE $20

Cat. QC-3602 **$179.00**

Two Output Video Splitter

Split signal without loss!

Share a live feed from a camera between a monitor and recorder etc and don't worry about any signal loss. Requires 12VDC or 24VAC power.

Was $49.95 SAVE $10

Cat. QC-3435 **$39.95**

USB Pan / Tilt PC Camera with Remote Access

This is one of the most useful PC based cameras we have seen!

It has full functionality as a pan/tilt camera, with motion controlled via the serial port! You can log onto a preset IP address, and actually take control of the pan/tilt functions. Software and drivers are supplied on CD-ROM, and it is compatible with Windows 98,SE,ME,2000, and XP.

•640 x 480 pixels resolution.
•Colour CMOS sensor.
•111(L) x 97(W) x 86(H)mm approx.

Cat. QC-3395 **$399.00**

CMOS Cameras with Telescope and Microscope Mount

Great for science discoveries!

They have a colour 350k pixel sensor (with around 230TV lines resolution) with a standard composite video output.

Telescope Camera

Cat. QC-3240 Cat. QC-3240 **$189.00**

Microscope Camera

Cat. QC-3242 Cat. QC-3242 **$199.00**

4 Way Cat 5 Balun

Long distance video cabling!

Use UTP Cat5 cable for transmitting video signals over distances up to 500 metres! Transmission range is dependent on cable and video type, and a Balun is required at each end.

Cat. QC-3427 **$79.95**

Great Savings on Surveillance Cameras and Equipment

B&W CCD Camera with IR Illumination

•380TV line resolution.
•92° lens angle.
•52 x 42 x 16mm.
Was $99.95

Cat. QC-3468 **$79.95** SAMSUNG SENSOR INSIDE SAVE $20

B&W CCD Dome Style Camera

•380TV line resolution.
•92° lens angle.
•100(W) x 60(Dia)mm.
Was $90

Cat. QC-3472 **$70.00** SAMSUNG SENSOR INSIDE SAVE $20

B&W CCD Pinhole Camera with Audio

•420TV line resolution.
•90° lens angle.
•25 x 25 x 20mm.
Was $149

Cat. QC-3473 **$129.00** SAMSUNG SENSOR INSIDE SAVE $20

Colour CCD Camera with Audio

•380TV line resolution.
•70° lens angle.
•36 x 36 x 16mm.
Was $199

Cat. QC-3494 **$189.00** Panasonic SENSOR INSIDE SAVE $10

Colour CCD Dome Camera

•380TV line resolution.
•70° lens angle.
•100(W) x 60(Dia)mm.
Was $219

Cat. QC-3489 **$199.00** Panasonic SENSOR INSIDE SAVE $20

High Resolution Colour CCD Pro Camera with Auto-Iris Control & Audio

•420TV line resolution.
•120 x 63 x 52mm.
Was $249

Cat. QC-3314 **$229.00** Panasonic SENSOR INSIDE SAVE $20

Ultra High Resolution Colour CCD Pro Camera with Auto Iris

•480TV line resolution.
•118 x 62 x 50mm.
Was $349

Cat. QC-3307 **$299.00** Panasonic SENSOR INSIDE SAVE $50

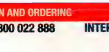
CCTV Auto Iris Lens

•Made in Japan.
•Aperture between f1.4 and f88.
•4mm CS mount lens.
Was $349

Cat. QC-3320 **$299.00** SAVE $50

4 Channel Video Surveillance Capture Card

•Real time video compression.
•Digital motion detection.
•Simultaneous record and playback. **Was $349**



Cat. QV-3056 **$299.00** SAVE $50

4 Channel B&W Quad Processor

•Switching or quad display.
•256 level grey scale.
•240(W) x 45(H) x 150(D)mm.
Was $179

Cat. QC-3361 **$159.00** SAVE $20

960 Hour Time Lapse VCR

•960 hours recording on a standard E-180 tape.
•Alarm trigger recording.
•Four head system.
Was $699

Cat. QV-3053 **$599.00** SAVE $100

Professional Aluminium Camera Housing

•Weatherproof construction.
•Integrated sun shade.
•100(W) x 112(H) x 390(L)mm.
Was $39.95

Cat. QC-3330 **$34.95** SAVE $5

Modified Square Wave Inverters

NEW 2004

Great value! They have a host of safety features such as overload and short circuit protection, dielectric isolation between the battery and secondary voltages, and much more. They all have excellent surge ratings and boast over 90% efficiency.

GREAT NEW RANGE

Power	Surge	VDC	VAC	Cat. No.	Price
100W	(300W)	12	to 230	MI-5100	$59.95
150W	(450W)	12	to 230	MI-5102	$79.95
300W	(1000W)	12	to 230	MI-5104	$119.95
400W	(1200W)	12	to 230	MI-5106	$159.95
400W	(1200W)	24	to 230	MI-5107	$169.95
600W	(1500W)	12	to 230	MI-5108	$249.95
800W	(2000W)	12	to 230	MI-5110	$299.95
1000W	(2500W)	12	to 230	MI-5112	$399.95
1500W	(3500W)	12	to 230	MI-5114	$599.95

Pure Sine Wave Inverters

Great reliability! Pure Sine Wave inverters provide a mains waveform that is much closer to that of conventional mains supplies. This is much better, and sometimes required when powering sensitive equipment, some switchmode power supplies, and more.

Power	Surge	VDC	VAC	Cat. No.	Price
150W	(300W)	12	to 230	MI-5080	$229
300W	(500W)	12	to 230	MI-5082	$299
500W	(1000W)	12	to 230	MI-5085	$329
1000W	(2000W)	12	to 230	MI-5088	$799
1500W	(2500W)	24	to 230	MI-5089	$999

Solar Panel Voltage Regulators

Protect your appliances!

12V solar panels can sometimes supply up to 18VDC. Run a regulator inline to keep this voltage under maximum ratings.

12V 1.5A Charging Regulator

Cat. AA-0258 $22.95

12V 20A Solar Panel Regulator

Cat. HP-3126 $69.90

Want to use Solar but Don't Know How? We have books to help you!

Solar Electricity

Find out everything you need to know about solar systems.

Cat. BE-1532 $34.95

Build Your Own Direct Charging Plant

Explains charging systems for remote and mobile power installations.

Cat. BE-1530 $24.95

Small Solar Panels

Ideal for charging SLA batteries!

Supplied with reverse current diode, 2m lead with alligator clips.

12V 1.26 Watt

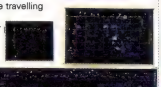
Cat. ZM-9016 $39.95

12V 4.5 Watt

Cat. ZM-9018 $99.95

BP Solar 12V Polycrystalline Solar Panels

Top quality panels at a great price! Each panel has an array of 36 Polycrystaline cells, and can charge 12V batteries in virtually any climate. They are built to last, and designed to withstand a 25mm hail stone travelling at terminal velocity. They are mounted in an anodised aluminium frame that is weather and corrosion resistant. See website for full details.



Power	Warranty	Cat	Price
10W	10 Year	ZM-9060	$235
20W	10 Year	ZM-9062	$359
80W	20 Year	ZM-9069	$799

Amorphous Type Solar Panels

Very affordable! These are Amorphous Silicon type solar panels offering excellent quality, and value for money. Be aware of cheap Amorphous solar panels which will simply not give the claimed output power. All our panels will give claimed power at 340°S latitude, ie, Sydney. Amorphous power output gradually decreases over the years, unlike polycrystalline which do not.

Voltage	Power	Cat No.	Price
6 Volt	1 Watt	ZM-9020	$29.95
12 Volt	2 Watt	ZM-9024	$39.95
12 Volt	4 Watt	ZM-9026	$69.95
12 Volt	10 Watt	ZM-9030	$139.00
12 Volt	15 Watt	ZM-9045	$199.00

LIGHT UP YOUR GARDEN THIS SUMMER!

Stainless Steel Pagoda

•140(H) x 75(Dia)mm excluding cap, fins, and spike.

Cat. SL-2702 $34.95

Stainless Steel Tall Pagoda

•220(H) x 75(Dia)mm excluding cap and spike.

Cat. SL-2700 $39.95

Die-Cast Pagoda

•300(H) x 140(Dia)mm excluding spike.

Cat. SL-2784 $28.00

Die-Cast Pathway Illuminator

•170(H) x 60(Dia)mm excluding spike.

Cat. SL-2780 $22.50

Die-Cast Garden Floodlight

•310(L) x 75(Dia)mm including spike.

Cat. SL-2770 $22.50

Die-Cast Flush Mount

•100(H) x 96(Dia)mm, can be walked on.

Cat. SL-2776 $22.50

Stainless Steel Flush Mount

•72(H) x 62(Dia excluding flange)mm. Can be used in pools underwater.

Cat. SL-2704 $79.95

Check out our website for all details and specs, and also our great range of garden lighting transformers!

Stainless Steel Surface Mount Adjustable Spotlight

•75(L) x 62(Dia)mm, 78(Dia)mm base.

Cat. SL-2710 $79.95

Stainless Steel Spike Mount Adjustable Spotlight

•72(H) x 62(Dia)mm excluding spike.

Cat. SL-2708 $69.95

Die-Cast Wall Mount Step Light

•100(Dia) x 50(D)mm.

Cat. SL-2778 $16.75

Stainless Steel Flush Mount with Cover

•72(H) x 62(Dia excl. flange and hood)mm.

Cat. SL-2706 $89.95

Die-Cast Focal Spotlight

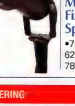
•320(L) x 95(Dia)mm including spike.

Cat. SL-2772 $22.50

Die-Cast General Purpose Spotlight

•100(H) x 96(Dia) excluding spike and bracket.

Cat. SL-2774 $22.50



Stainless Steel Surface Mount Fixed Spotlight

•75(L) x 62(Dia)mm, 78(Dia) base.

Cat. SL-2712 $79.95

FOR INFORMATION AND ORDERING
TELEPHONE> 1800 022 888 INTERNET> www.jaycar.com.au

NEW HARDCORE ELECTRONICS!

This section is dedicated to what's new for the Hardcore Enthusiast.

Stadium Double Insulated Degaussing Wand

For the serious Techie!

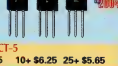
ATTENTION TV MONITOR REPAIR TECHNICIANS
Grab one of these now as they are getting scarce!

A degaussing wand is used to correct the false colour that appears on TVs and CRT monitors when a strong magnet (such as a loudspeaker) comes near the screen. One zap with this product and your TV/Monitor's natural reproduction is restored.
•240VAC, 1.8m mains lead.

Cat. TH-2480 **$79.95**

Low Dropout Voltage Regulators

Datasheets available on our website.



5 Volt 1 Amp LM294 OCT-5
Cat. ZV-1560 1+ $6.95 10+ $6.25 25+ $5.65

12 Volt 1 Amp LM294 OCT-12
Cat. ZV-1562 1+ $6.95 10+ $6.25 25+ $5.65

12 Volt 3 Amp LM1085 IT-12
Cat. ZV-1564 1+ $7.95 10+ $6.95 25+ $5.95

HSS Step Drill Bits - 1mm steps

Drill multiple size holes with the one bit!
Suitable for plastics and un-hardened metals (such as aluminium or copper sheeting etc) up to 4mm thick! Made from high speed steel (HSS): Two sizes available:

4 - 12mm Cat. TD-2436 — Cat. TD-2436 **$19.95**

12 - 20mm Cat. TD-2438 — Cat. TD-2438 **$29.95**

New Microcontrollers!

PIC PIC16F88
Cat. ZZ-8530 1+ $12.95 10+ $11.35 25+ $10.25

PIC PIC16F877A
Cat. ZZ-8540 1+ $12.95 10+ $11.35 25+ $10.25

ATMEL AT90S1200
Cat. ZZ-8750 1+ $12.95 10+ $11.35 25+ $9.95

ATMEL ATMEGA 16-8PC
Cat. ZZ-8755 1+ $24.95 10+ $22.35 25+ $20.25

ATMEL ATMEGA 32-8PC
Cat. ZZ-8760 1+ $29.95 10+ $26.90 25+ $24.25

ATMEL ATMEGA 8515-8PC
Cat. ZZ-8765 1+ $23.95 10+ $21.35 25+ $19.25

Keyring Voltage and Leakage Tester

Very clever!
This great device will flash when voltage, static radiation, or microwave radiation is detected. Also features a small integrated torch.

Cat. QP-2278 **$9.95**

Magtrix Magnetic Connectors

Need to be seen to be believed!
Extremely versatile and provide a unique and reliable electrical connection that can disconnect and reconnect without fuss. Ideal for a myriad of projects where connecting and disconnecting power can be a problem. Reverse polarity conscious, sold as a pack of 3 matching pairs.

Cat. PP-0050 **$4.95**

TDA1905 5W Audio Amp IC BARGAIN

SCOOP PURCHASE!
It is a 5W audio amplifier with an internal muting facility. 16 DIP package, data sheets are available on our website and are included with the 100 pack.

Cat. ZL-3600 **$3.95 ea** | Cat. ZL-3602 **$34.50 pk 10** | Cat. ZL-3604 **$200 pk 100**

WE HAVE A NEW RANGE OF SMD COMPONENTS IN STORE NOW!

Tamiya Model Tyres

Ideal for model car robotics projects!
Two types available:

Truck Tyres - Set of 4.
Includes 4 x 36mm dia tyres, hubs to suit, and 2 x 100mm axles.

Cat. YG-2860 **$9.95**

Sports Tyres - Set of 2.
Includes 2 x 56mm dia tyres, a set of wide and narrow hubs to suit, screws, nuts & two small wrenches.

Cat. YG-2862 **$16.95**

GPO Mains and Earth Leakage Tester

Make GPO installation and checking a breeze!
Identifies problems with wiring, and checks earth leakage circuit breakers using selectable trip current. A must have for electricians and handymen.

Cat. QP-2000 **$19.95**

Digital Vernier Caliper

No eye strain taking readings!
The clear LCD shows the measurement in mm or inches. Accurate to 0.01mm.

Was **$79.95** — Cat. TD-2882 **$69.95** — SAVE $10

3.6V Rechargeable Cordless Screwdriver

Take the strain out of your wrists.
Use our powered screwdriver and install or remove multiple screws with ease.
Was $19.95 — Cat. TD-2495 **$14.95** — SAVE $5

1000V 7 Piece Screwdriver Set

GS and VDE tested and approved.
Soft rubber grip handles, with insulation right to the tip.
CHECK THIS GREAT PRICE!

Cat. TD-2022 **$19.95**

1W Luxeon Brand LEDs

Up to 120 Lumens per LED!
They have a 100,000 hour LED life expectancy, are fully dimmable with excellent ESD protection.

Red	**Cat. ZD-0400**	**$14.95**
Orange	**Cat. ZD-0401**	**$14.95**
Green	**Cat. ZD-0402**	**$16.95**
Blue	**Cat. ZD-0403**	**$16.95**
White	**Cat. ZD-0404**	**$16.95**

Precision Mini Metal Lathe Deal

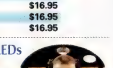
$107.80 worth of parts already included!

Industrial quality on a budget!
This fantastic unit has a FULL cast iron bed, frame, and head stock assembly, just like industrial lathes. It bristles with safety features including a plastic chuck cover which must be down for the machine to operate. This prevents you from starting the lathe with the chuck-key in! We have not seen a product of this quality, at this price. See website for details. **The cutting tools, drill chuck, and live centre and all usually sold extra, costing over $100 more, but are included in the price!**

Cat. TL-4000 **$899.00**

Economy Brand 1W LEDs

Cost effective alternative!
We believe our in-house brand economy LEDs are just as bright as the Luxeon counterparts, at a much cheaper price. See website for data.



Red	**Cat. ZD-0410**	**$10.95**
Green	**Cat. ZD-0412**	**$12.95**
Blue	**Cat. ZD-0414**	**$12.95**
White	**Cat. ZD-0416**	**$12.95**

SMART CARDS SLASHED!

We have drastically reduced prices on all of our smart cards!
Grab a bargain before they are sold out!

'GOLD' wafer card with PIC16F84A + 24LC16B EEPROM.
Cat. ZZ-8800 Was $7.95 — SAVE $2 — **Now $5.95**

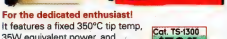
'SILVER' wafer card with PIC16F877 + 24LC64 EEPROM.
Cat. ZZ-8810 Was $19.95 — SAVE $10 — **Now $9.95**

'EMERALD' wafer card with PIC16F628 + 24LC64 EEPROM.
Cat. ZZ-8820 Was $24.95 — SAVE $10 — **Now $14.95**

'FUN' wafer card with AT90S8515A ATMEL + 24LC256 EEPROM.
Cat. ZZ-8806 Was $19.95 — SAVE $10 — **Now $9.95**

portasol Gas Soldering Tools
World renowned quality, made in Ireland

Portasol 50



For the dedicated enthusiast!
It features a fixed 350°C tip temp, 35W equivalent power, and around a 30min run time. Flint ignitor in cap.

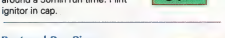
Cat. TS-1300 **$39.95**

Portasol Technic

For a little more control!
It features a variable tip temp up to 450°C, 10-60W equivalent power, and around a 60min run time. Flint ignitor in cap.

Cat. TS-1305 **$49.95**

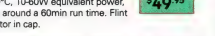
Portasol Pro Piezo



Excellent versatility!
It features a variable tip temp up to 580°C, 15-75W equivalent power, and around a 45min run time. Internal piezo ignition.

Cat. TS-1310 **$89.95**

Portasol Super Pro



Power to spare!
It features a variable tip temp up to 480°C, a MASSIVE 25-125W equivalent power, and around a 2 hour run time. Internal piezo ignition.

Cat. TS-1320 **$109.00**

Pro Piezo Soldering Kit

A great way to start!
It contains a Pro Piezo iron, cleaning sponge and tray, 2.4mm tip, as well as hot air, hot knife, and hot air deflector tips. Includes storage case.

Cat. TS-1318 **$119.00**

Super Pro Soldering Kit

All you'll ever need!
It contains a Super Pro iron, cleaning sponge and tray, 2.4mm tip, 4.8mm tip, as well as hot air, hot knife, and hot air deflector tips. Includes storage case.

Cat. TS-1328 **$149.00**

60W SMD Soldering Tweezers

The best way to solder SMD.
Solder and desolder small components or large flat pack ICs. Tips available from 2 to 20mm. 2mm tips supplied.
Was $99.95

SAVE $30

Cat. TS-1700 **$69.95**

18W Professional Soldering Iron

Perfect for precise soldering!
It offers rapid heat up, instant recovery, stainless steel barrel, and iron clad chrome plated tip.

Was $34.95

Cat. TS-1551 **$29.95**

SAVE $5

40W DURATECH Soldering Iron

Ideal for hobbyists and handy-work!
Stainless steel barrel, and an orange cool grip, impact resistant handle. Mains powered, fully approved.

Was $16.95

SAVE $4

Cat. TS-1475 **$12.95**

Solder Flux Pen

Ideal for SMD rework!
Applying the flux to solder joints will aid re-flow when heating to remove components, or it can be applied to tracks for excellent solder-ability.
Was $12.95

Cat. NS-3035 **$9.95**

SAVE $3

Metal Desolder Tool

Super strong suction!
Simple spring plunger action for desoldering. 195mm including tip.
Was $15.75

Cat. TH-1862 **$12.75**

SAVE $3

Deluxe goot Desolder Tool

Made in Japan!
The highest build quality for years of service. Measures 330mm long.
Was $24.95

SAVE $5

Cat. TH-1856 **$19.95**

Butane Gas

Suits all of our gas powered devices!
Includes five different nozzles to suit most devices, and filling instructions. 150g can.

Techstore Customers: Must be sent using road freight

Cat. NA-1020 **$5.95**

WE ALWAYS HAVE GREAT PRICES ON SOLDERING STATIONS

goot Antistatic Soldering Station

High quality, great price!
If you want a fantastic soldering station that won't break the bank, the Goot is for you. It is ESD safe, has a digital temperature adjustment from 200 to 480°C at 65W, and a lightweight soldering pencil.

Cat. TH-1440 **$229.00**

DURATECH Antistatic Soldering Station

Fantastic price!
Our Duratech soldering station offers fantastic value for money. It offers adjustable temperature between 150 and 450°C. The tip fits right over the heating element for low hysteresis time. See our website for details.

Cat. TS-1380 **$159.00**

Screwdriver Helper

Torque transfer compound.
It dramatically increases the amount of torque you can apply to a screw head without slipping. 14g bottle.
Was $13.95

Cat. NM-2830 **$10.95**

SAVE $3

Self Amalgamating Tape

Extremely versatile!
Cures into a single mass once applied, to help seal and waterproof wires or even pipes. 10m roll.
Was $22.50

SAVE $5

Cat. NH-2826 **$17.50**

Economy Vernier Caliper

Cheap and accurate!

This plastic unit is great as a spare, or just as a cheap caliper for everyday use.

Cat. TD-2080 **$4.95**

PC Board Holder

Make light work of PCB handling!
Two spring loaded alligator clips grip the board, and a sturdy cast iron base keeps it steady.
Was $10.95

SAVE $2

Cat. TH-1982 **$8.95**

1Kg Reels **$28.95 each**

0.71mm Cat. NS-3002
1.0mm Cat. NS-3015

200g Reels **$6.95 each**

0.71mm Cat. NS-3005
1.00mm Cat. NS-3010

15-20g Hobby Canisters

0.71mm Cat. NS-3008
1.00mm Cat. NS-3013
$1.65 each

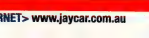
7 Pc Hex Nut Driver Set

Excellent quality.
Each driver contains a deep socket and duplex colour non-slip rubber handle. 3 - 6mm sizes in 0.5mm steps.
Was $29.95

Cat. TD-2007 **$24.95**

SAVE $5

Wire Stripper / Cutter Pliers



No toolbox should be without one.
Strips wire from 0.9mm to 5.5mm, made from a hardened alloy steel with rubber handles. **Was $12.25**

Cat. TH-1825 **$9.25**

SAVE $3

Vacuum Bench Vice

Die-cast aluminium construction!
Great if you only occasionally need a vice on your workbench. It attaches and detaches without leaving a mark.
Was $57.95

Cat. TH-1766 **$47.95**

SAVE $10

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All the instruction, and more!

It shows, in full colour, the constructed modules, has colour overlay diagrams, detailed build guides, and fitting instructions. It also includes chapters on how engine management works, advanced engine management, electronic car systems like ABS and traction control, DIY electronic modification, and more! It is a definitive must-have if you are building any of these kits, or would just like to know how your car's electronics work. Over 150 pages!

Cat. BS-5080 **$19.80**

Digital Fuel Adjuster Kit

Complete fuel injector mapping!

Upgrade injectors then tune the fuel system for optimum performance. Requires the KC-5386 Hand Controller for programming.

Cat. KC-5385 **$79.95**

Hand Controller Kit for Digital Adjusters

Programming or real time display!

It controls the KC-5385 Digital Fuel Adjuster, KC-5384 Digital Pulse Adjuster & KC-5387 Independent Electronic Boost Controller. Program remove or leave connected for real time display!

Cat. KC-5386 **$59.95**

Digital Pulse Adjuster Kit

Add an extra injector! It can be completely programmed over the entire load range with excellent mapping resolution. Requires the KC-5386 Hand Controller for programming.

Cat. KC-5384 **$79.95**

Independent Electronic Boost Controller Kit

Superior control over the boost curve! Features two individually programmed curves for a "wet & dry" or "street and race" type boost setup. Requires the KC-5386 Hand Controller for programming.

Cat. KC-5387 **$79.95**

LED Duty Cycle Meter Kit

Super fast sampling rate!

It measures the exact injection pulse from your ECU, and displays it on a pair of LED displays. Relay output to cut-in another injector and more!

Cat. KC-5375 **$54.95**

High Range Adjustable Temperature Switch Kit with LCD

Huge range – measures up to 1200°C! Heat can be a problem in any car, but more so in a performance car. Monitor temperatures or switch a relay at a preset level for alarms, extra cooling systems, etc.

Cat. KC-5376 **$69.95**

Nitrous Fuel Mixture / Motor Speed Controller Kit

Save a fortune over pre-built units!

Use it with an injector to fire nitrous fuel into your engine, or control an electronic water pump etc.

Cat. KC-5382 **$24.95**

Peak Hold InjectorAdaptor Kit

Peak hold injectors? No worries!

Some cars are fitted with 'peak hold' injectors rather than the more common 'pulse' type. This kit allows our pulse modulating kits (eg Digital Pulse Adjuster) to be used with peak hold injectors.

Cat. KC-5395 **$19.95**

Intelligent Turbo Timer Kit

Take care of your turbo!

It determines how hard you have been driving, and idles the motor for an appropriate period after ignition switch off to assist in turbo cooling.

Cat. KC-5383 **$44.95**

Universal Voltage Switch Kit

Adaptable to many applications!

It trips a relay when a preset voltage is reached. It can also detect rising and falling voltage (such as backing off accelerator, increase in air flow etc).

Cat. KC-5377 **$29.95**

Frequency Switch Kit

Versatile and functional!

It trips a relay based on an input from a tacho, road speed, and many other pulse type inputs. It can also detect rising or falling frequency such as RPM rising or falling.

Cat. KC-5378 **$35.95**

High Performance Timer Kit

Not your average timer! It is quite clever, and can be used to keep something running for a preset time or trip the relay at intervals eg. 1 second every 9 for intermittent device operation.

Cat. KC-5379 **$39.95**

Economy Temperature Switch Kit

Excellent functionality!

It will trip a relay when a preset temperature is reached, and works up to 245°C. It uses a small NTC Thermistor for fast temperature switching

Cat. KC-5381 **$29.95**

Digital Speedo Corrector Kit

Re-calibrate your speedo! If you upgrade your gearbox or change diff ratios, your speedo may not read correctly. This project compensates at a programmed level, working with electronic speed sensors.

Cat. KC-5380 **$44.95**

Smart Fuel Mixture Display Kit

Keep an eye on fuel mixture!

It not only displays the mixture on a series of LEDs, but also features an auto dimming display for night driving, and critical lean out alarm.

Cat. KC-5374 **$27.95**

Emergency Brake Light Trigger Kit

Safety first! This project automatically switches on your brake lights when you quickly release your foot off the accelerator, pre-empting your foot touching the brake.

Cat. KC-5373 **$24.95**

Don't forget about our regular range of great automotive kits too!

Universal High Energy Ignition Kit

Better fuel efficiency and performance. Ref: SC June 98. A fixed 0.9ms high voltage spark results in more complete fuel burning which increases efficiency and performance, while reducing emissions.

Cat. KC-5247 **$52.95**

Digital Tachometer Display Kit

Dual display!

Ref: SC April 2000. It features four 7-segment LED displays for a numerical tachometer display, and a line of 10 LEDs for an effective "at a glance" bar graph. Available from our Kit Back Catalogue and selected stores only.

Cat. KC-5290 **$62.95**

Digital Fuel Mixture Display Kit

Keep a close eye on fuel mixture! Ref: SC Dec/Oct 2000. This kit not only displays a bar graph for a quick rich/lean indication, it gives you an actual numeric readout with 440ms sampling.

Cat. KC-5300 **$62.95**

Rev Limiter / Gear Shift Indicator Kit

Three stage shift indication!
Ref: SC April 99.
It features three lamps that light in succession on the way to 'red line', and can function as a rev limiter with the use of the KC-5255 Engine Immobiliser Kit.

Cat. KC-5255 **$34.95**

Compact 0 - 80A Ammeter Kit

A must for anyone with a large stereo install!

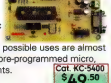
Ref: SC June 2002. It displays +/- 30A current on the bar graph display for regular load conditions, and up to 80 amps on the three digit LED display. Available from our Kit Back Catalogue and selected stores only.

Cat. KC-5336 **$74.95**

SMS Controller Kit

Control appliances from anywhere!

Ref: Silicon Chip Nov 2004. The SMS controller kit works with Nokia 3210, 3310, 5110, and 6110 models to control electronic outputs, and gives you a host of control options. The possible uses are almost endless! Kit includes PCB, pre-programmed micro, and all electronic components. Requires Nokia data cable.



Cat. KC-5400 **$49.90**

Video Enhancer and Y/C Separator Kit

Convert composite video to S-Video and enhance it!

Ref: Silicon Chip August 2004. Planning to transfer your VHS videos to DVD with your computer? This project enhances & sharpens the picture, as well as converting to S-Video for a high quality transfer! Kit supplied with through-hole plated and solder masked PCB, case, silk screened and laser cut panels, quality Belden RG58 cable, mains plug pack, and all electronic components.

The Jaycar kit is supplied with genuine Belden RG58 A/V cable. This cable has a known, consistent propagation delay so you can be confident the propagation delay will be spot on. Beware of inferior kits that use cheap "house" brand cable that might have wildly variable propagation delay characteristics.

Cat. KC-5394 **$179.00**

USB Mains Board Switch Kit

Automatic peripheral switching!

Ref: Silicon Chip Nov 2004. This project allows you to have your peripheral devices switch automatically when you switch on your USB equipped PC. It will fit INSIDE many power boards, so you won't even know it's there! Kit includes PCB & all electronic components.

Requires a mains powerboard.

Cat. KC-5401 **$19.95**

Portable Door Bell Kit

Take the doorbell out to the pool!

Ref: Silicon Chip Sept '04. It uses the wireless transmitter from our witty Remote Controlled Fart Gadget. This means you can take the battery powered receiver out to the backyard with you etc., so you will always here it. Kit supplied with PCB and all electronic components.

Requires GH-1088 Fart Gadget - $19.95

Cat. KC-5397 **$14.95**

Dr Video Kit MkII

An even better video stabiliser!

Ref: Silicon Chip June '04. Movie companies deliberately tamper with the video signal to restrict copying, but this robs you of the true high quality picture your system is capable of and you deserve. Get the picture you paid for and strip out these annoying signals from composite or S-video. Kit includes PCB, case, panels and all electronic components.

Cat. KC-5390 **$99.95**

RGB to Component Video Converter Kit

Video Standards Converter

Ref: Silicon Chip August 2004. Enjoy the high quality of RGB video when your projector, plasma TV etc only supports Component video inputs. Kit includes PCB, case, silk-screened and punched panels, colour coded RCA sockets, 9VAC plugpack, and all electronic components.

Cat. KC-5398 **$89.95**

Component to RGB Converter Kit

Superior video quality!

Ref: Silicon Chip May 2004. Component video is the best quality format available, but it your TV or Plasma screen etc only accepts RGB inputs? Build this unit and get the best out of your equipment. Kit includes PCB, case, silk screened punched panels, colour coded RCA sockets, 9VAC plugpack, and all electronic components.

Cat. KC-5388 **$99.95**

Luxeon Star LED Driver Kit

Power 1W, 3W, and 5W Luxeon LEDs from a 12V source!

Ref: Silicon Chip May '04. Save $$$ off purchasing pre-built drivers. Kit includes PCB, and all electronic components.

Cat. KC-5389 **$29.95**

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USB Power Injector Kit

A power boost for your USB port.

Ref: SC Oct 2004. This project allows full current to be drawn from USB peripheral devices. Kit includes PCB, case, silk screened and punched panels, and all electronic components.

Cat. KC-5393 **$29.95**

Interior Light Delay Kit MkII

A great modification for your car!

Ref: Silicon Chip June 2004. The new model interior light delay kit features a great fade out effect, and simplified wiring, even when used with modern cars. Kit includes PCB, case, and all electronic components.

Cat. KC-5392 **$18.95**

Micromitter Stereo FM Transmitter Kit

Transmit quality audio to your FM stereo!

Ref: Silicon Chip Dec 2002. Crystal locked to a preset frequency to eliminate frequency drift. Kit includes PCB, case, silk screened front panel, and all electronic components.

Cat. KC-5341 **$49.95**

Valve Audio Preamp Kit

Experience the warmth from a valve preamplifier!

Ref: SC Nov 03, Feb 04. Valve amplifiers are said to have a 'warmer' sound that transistor counterparts. Now you can find out for yourself. Includes PCBs, case, 12AX7WA valve, bobbin, core and clips, and all electronic components.

Cat. KC-5370 **$89.95**

Second Channel Valve Add-On Kit

Make it a stereo pre-amp.

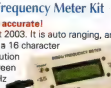
Powered by the power supply in KC-5370. Includes PCB, valve, and all electronic components.

Cat. KC-5371 **$59.95**

50MHz Frequency Meter Kit

Cheap and accurate!

Ref: SC Oct 2003. It is auto ranging, and displays on a 16 character LCD. Resolution varies between 0.1 and 10Hz depending on the input frequency. Includes all components and hardware. Requires probe.



Cat. KC-5349 **$69.95**

AC/DC Current Clamp Meter Kit for Multimeters

Turn your DMM into a clamp meter!

Ref: SC Sept 2003. It can be used to measure up to 630A AC, and works with most multimeters. Includes all components & parts.

Cat. KC-5368 **$34.95**

Auto Power-Up Kit

A must have for computers and home theatre!

Ref: Silicon Chip July 2003. Switches auxiliary appliances on or off when a main unit is switched on or off. Kit includes PCB, case with silk screened lid, pre-cut toroidal core, mains lead and sockets, and all electronic components.

Cat. KC-5363 **$69.95**

AVR-ISP Serial Programmer

Easy to use!

Access and modify the date memory in your AVR microcontroller without even removing it from the application circuit! Includes PCB, case, and all components.

Cat. KC-5340 **$45.00**

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11-04

The Driveway Sentry

By JIM ROWE

Here's a low cost, easy to build and install sensor system for detecting moving vehicles like cars, trucks, tractors or other farm machinery. It can also be used to detect the opening and closing of metal gates and roller doors.

Unlike other sensing systems that use light, heat or ultrasonic sound waves to detect motion, the Driveway Sentry operates by sensing small changes in the Earth's magnetic field – the same magnetic field that is sensed by a compass.

Since cars, trucks and similar vehicles contain a significant amount of ferrous metal (iron, steel etc), they inevitably produce small temporary changes in the Earth's magnetic field when they move into or through an area.

That's how the Driveway Sentry detects them, using a special high-sensitivity shielded remote sensor unit.

Because it doesn't generate any sensing fields of its own, the Driveway Sensory produces no environmental pollution of any kind; it's quite 'clean'.

Also, because it only senses moving iron and steel objects like vehicles, it is much more selective than other kinds of sensor.

This makes it immune to false alarms from birds, dogs, cats, sheep, cattle and other animals, falling tree branches, rain and snow, people walking past and so on.

At the same time it can be used to detect the movement of vehicles which

MAIN FEATURES

Exit Delay: Allows the system to be switched to non-sensing 'sleep mode' for a period of about six minutes, to allow the owner's vehicle to exit from the property without activating the Driveway Sentry. At the end of the Exit Delay period, the system returns to its movement sensing mode.

Test Button: Allows the system to be manually triggered into 'movement detected' alarm mode, without having to drive a vehicle past the remote sensing unit. This makes system adjustment much easier and more convenient.

Piezo Buzzer: Produces a high-pitched sound to attract your attention when movement is detected. This sound can be disabled if you prefer the system to respond silently.

Relay Contacts: The Driveway Sentry control box includes a DPDT relay with two sets of changeover contacts. These are activated when the system detects movement, allowing the Sentry to be connected to security systems, telephone diallers, radio transmitters and so on. It can also be used to control mains lighting, electric gates or other equipment, via an external mains-rated relay.

Alarm Duration Control: Allows the duration of the system's 'movement detected' alarm mode to be adjusted between a minimum of two seconds and a maximum of about 25 seconds.

Probe Sensitivity Control: Allows the sensitivity of the Sentry's remote sensing unit to be adjusted over a wide range, so it can be set for reliable vehicle (or gate or door) movement detection without being too sensitive and susceptible to false alarms.

Low Power Consumption: Operates from 12V DC power, with a low current drain and power consumption – less than 70mA (0.84 watts), even in 'movement detected' alarm mode. This means that the system can be operated from a 12V battery and/or solar power in rural and other remote situations.

contain very little ferrous metal – like aluminium trailers, boats and caravans - simply by attaching a strong magnet to the underside of their frame. The magnet ensures that if they're moved past the Driveway Sentry's remote sensor unit, the Earth's magnetic field will be disturbed locally and the system will activate.

The Driveway Sentry can also be used to detect the opening or closing of a ferrous metal gate, or a roller door made from the same material, simply by placing the remote sensor unit in the appropriate position.

It can even be used to detect the opening and closing of non-ferrous (ie, timber or aluminium) gates or roller doors, again simply by attaching a magnet to them. In short, the Driveway Sentry has a multitude of motion-sensing uses around the home, farm or industrial facility.

By the way, the remote sensor unit doesn't have to be mounted directly under the driveway or gateway, so there's no need to cut a trench in your concrete drive. It's sufficiently sensitive to detect moving vehicles within a range of about 3-5 metres, so it will work quite well when buried in a shallow trench alongside the driveway or gateway.

The system operates from 12V DC and draws very little current: less than 30mA when 'armed' and waiting, and no more than 70mA when it senses movement and is 'alarmed'.

This means it's very economical and can easily be operated from a 12V battery and/or solar power, as an alternative to an AC plugpack supply.

The Driveway Sentry has been developed by Jaycar Electronics, and as a result the kit will only be available from Jaycar.

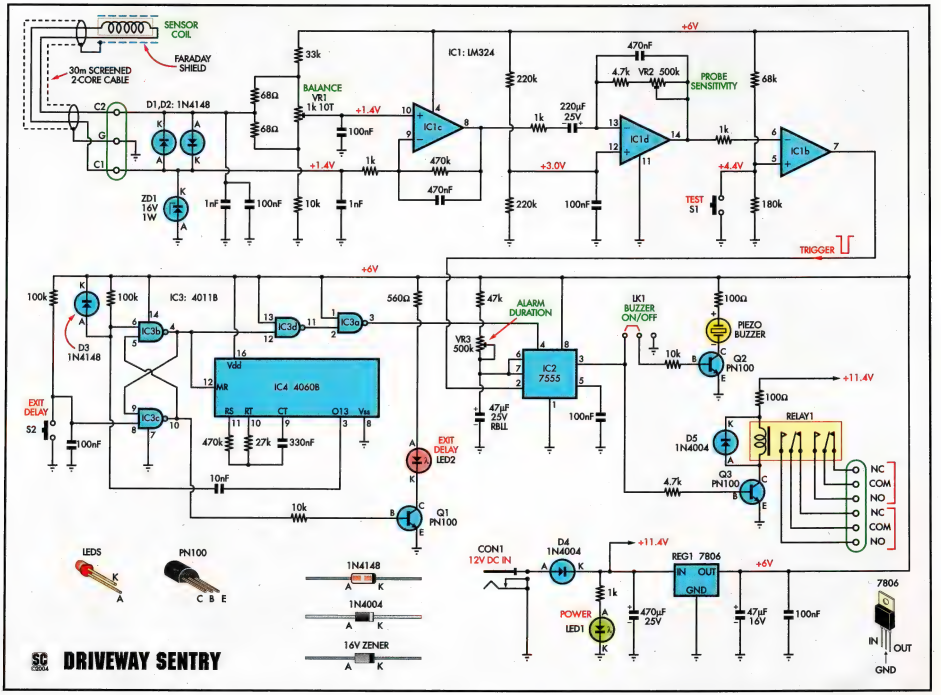
Because the project's remote sensing unit uses a special construction and involves many thousands of turns of fine wire, this will be supplied pre-built and sealed in a waterproof housing with 30m of special shielded cable attached. This should be sufficient to connect the sensor back to the Driveway Sentry in most home or business situations.

However if you need to monitor vehicle movement much further away from your house or office (say at a remote entrance gate or machinery shed), its alarm outputs can be connected back to your main security system via a VHF or UHF radio link.

How it works

The heart of the Driveway Sentry is its remote sensor, which as we said has many thousands of turns of fine wire wound on a long rod of 'soft' iron.

He's the Sentry you don't have to pay, feed or even be nice to . . . but he's ready and rearing to go 24 hours a day! This photo shows the control box and behind that, the sensor which is buried in the ground alongside your driveway.



DRIVEWAY SENTRY

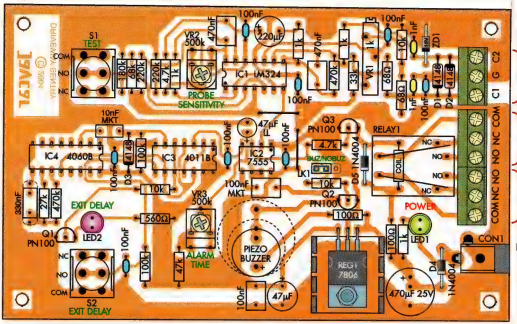


Fig. 1 (left): the complete circuit diagram, and Fig.2 (right): the PC board overlay. As you can see, various size piezo buzzers can be accommodated on this board. Note the comments about the relay in the text: neither its contacts nor the PC board tracks are rated to handle 240VAC – however, it can be used to switch an external 240VAC rated relay.

This makes the coil very sensitive to small changes in the Earth's magnetic field, of the type produced by a vehicle moving nearby. As a result of the magnetic field changes, the coil generates tiny low frequency AC voltages, and it's these that are fed back to the Control Box via twin shielded cable. They are then amplified and used to trigger the alarm circuit.

Because the sensor coil also tends to pick up a significant amount of electrical noise and mains hum, it must be fitted with a Faraday shield. This is a thin sheet of metal foil encasing the coil, providing it with an electrostatic shield (without also forming a shorted turn). The shield is connected back to the Control Box ground via the cable screening braid. The full circuit is shown in Fig.1.

Inside the box, the small voltages induced in the sensor coil are amplified by about 470 times in a DC amplifier stage using IC1c – one section of an LM324 quad op-amp.

Because of the high gain, this stage is provided with fine manual control over bias balancing, using 10-turn trimpot VR1. Diodes D1 and D2, along with zener diode ZD1 are used to protect IC1c from blocking or damage caused by induced voltage 'spikes'.

The output from IC1c is further amplified by IC1d, configured as an AC amplifier stage with gain adjustable between about 5 and 500 times using trimpot VR2.

This brings the peak amplitude of the amplified sensor coil signals up to a level where they are capable of being applied to IC1b, which compares them with a reference voltage of +4.4V from the voltage divider formed by the 68kΩ and 180kΩ resistors.

When the peak value of the amplified sensor signals exceeds the +4.4V reference level, the output of comparator IC1b switches low.

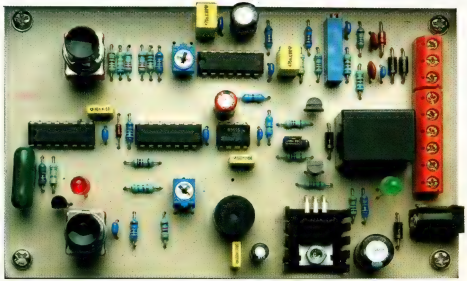
This negative-going pulse is used to trigger IC2, a 7555 timer IC configured as a one-shot. The output of IC2 (pin 3) then switches high, for a time period set by the RC time constant connected to pins 6 and 7. Trimpot VR3 allows you to adjust this alarm duration time between about two and 25 seconds.

When IC2 triggers on, it switches on transistor Q3 and operates the relay. The relay contacts can then be used to switch power to a siren, turn on security lights or trigger your main security system.

At the same time, the high level on pin 3 of IC2 can be used to turn on transistor Q2 which controls the small piezo buzzer mounted in the Driveway Sentry control box. If you don't want this internal buzzer to sound, it can be disabled by moving link LK1 over to the earthy side.

Note that pushbutton switch S1 can be used to temporarily ground the positive input of comparator IC1b. This forces the output of IC1b low, triggering IC2 in the same way as a signal peak from IC1d.

So S1 provides a handy Test function, allowing you to do things like adjust the alarm duration without



The completed PC board, as mounted in the jiffy box.

Parts List – Driveway Sentry

1 PC board, code DRIVSENT, 133 x 83mm
1 Jiffy box, UB1 size (158 x 95 x 53mm)
1 Magnetic Sensor potted coil assembly (Jaycar)
1 12V DPDT relay, 5A contact rating
1 piezo buzzer
2 DPDT pushbutton switches (S1,S2)
3 3-way terminal blocks, PC-mounting
1 2.5mm concentric power connector, PC-mounting
1 3-pin SIL header strip, with jumper shunt
1 19mm square U-shaped heatsink
4 M3 tapped spacers, 25mm long
4 M3 machine screws, 9mm long countersunk head
5 M3 machine screws, 9mm long round head
1 M3 hex nut and star lockwasher

Semiconductors

1 LM324 quad op amp (IC1)
1 7555 CMOS timer (IC2)
1 4011B quad NAND gate (IC3)
1 4060B binary counter (IC4)
1 7806 +6V regulator (REG1)
3 PN100 NPN transistors (Q1,Q2,Q3)
1 16V 1W zener diode (ZD1)
1 5mm green LED (LED1)
1 5mm red LED (LED2)
3 1N4148 silicon diodes (D1,D2,D3)
2 1N4004 1A silicon diodes (D4,D5)

Capacitors

1 470µF 25V RB electrolytic
1 220µF 25V RB electrolytic
1 47µF 16V RB electrolytic
1 47µF 25V RBLL electrolytic
2 470nF MKT polyester
1 330nF greencap or MKT
8 100nF multilayer monolithic ceramic
2 100nF MKT
1 10nF MKT
2 1nF disc ceramic

Resistors (0.25W 1%)

2 470kΩ	2 220kΩ	1 180kΩ	2 100kΩ	1 68kΩ
1 47kΩ	1 33kΩ	1 27kΩ	3 10kΩ	2 4.7kΩ
4 1kΩ	1 560Ω	2 100Ω	2 68Ω	

1 1kΩ trimpot, horizontal 10-turn (VR1)
2 500kΩ trimpots, horizontal (VR2,3)

WHERE TO GET THE KIT:

This project was designed and developed for Jaycar Electronics, who own the copyright to the circuit, PC board and illustrations.

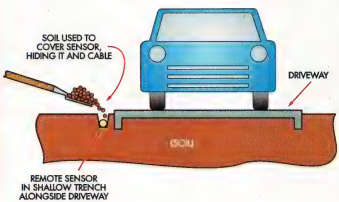
A kit of parts will be available exclusively from all Jaycar Electronics stores shortly after this issue goes on sale.

The kit (KC5402) has all components listed above, including the unique sensor coil and retails for $179.00 including GST.

Contact your nearest Jaycar Electronics store or visit www.jaycar.com.au

The remote sensor, potted inside its PVC pipe protective cover. Don't try to remove it – the chances are very high that you will damage or destroy it!

The drawing below shows how the sensor can be located in a trench alongside the driveway – you don't have to cut a hole in the concrete to use the Driveway Sentry.



having to drive a vehicle near the remote sensor unit.

All of the remaining circuitry around IC3 and IC4 is used to provide the Driveway Sentry's 'exit delay' function. This operates quite simply by holding the reset pin (pin 4) of IC2 low for a fixed period of about six minutes, after power is first applied to the Driveway Sentry or after pushbutton S2 is pressed at any later time. With its reset pin held low, IC2 is prevented from triggering during that time, allowing you to drive out in your own vehicle before the Sentry is re-armed.

The exit delay circuit consists of a simple R-S flipflop using IC3b and IC3c, two of the gates in a 4011B quad NAND gate. When power is first applied or when S2 is pressed, the flipflop is switched into its reset state (pin 4 low), by the temporary low on pin 8. This low is applied to the reset pin (12) of IC4, a 4060B oscillator/14-stage binary divider IC. IC4 is thus allowed to begin oscillating and counting.

This proceeds for around six minutes, after which IC4's pin 3 (output O13) finally drops to the low logic level. This negative-going edge is coupled via the 10nF capacitor back to pin 6 of IC3b, which switches the flipflop back into its set state. In this state pin 4 goes high, holding IC4 in its reset state and stopping its oscillator and counter.

At the same time, gates IC3d and IC3a (used as inverters) apply a logic high to the reset pin of IC2, allowing it to be triggered again. So the Driveway Sentry is re-armed.

Notice that during the exit delay time, there is a logic high on pin 10 of IC3c, the lower flipflop gate. This is used to turn on transistor Q1, which allows current to flow through LED2. This LED is therefore only illuminated during the exit delay period.

The power supply section of the Driveway Sentry is straightforward. Diode D4 provides reverse polarity protection on the 12V DC input, while regulator REG1 provides

a stable +6V supply for all of the electronics apart from the relay. LED1 gives indication that the Driveway Sentry has +12V power and is operating.

Construction

Apart from the remote sensor unit, all of the Driveway Sentry's components and circuitry are mounted on a small PC board measuring 133 x 83mm and coded DRIVSENT. It is mounted in a standard UB1 jiffy box measuring 158 x 95 x 55mm, which forms the control box. The remote sensor unit connects to it via the 30m shielded cable.

Since the remote sensor unit will be supplied fully built up, you will only have to wire up the control box - ie, fit the components to the PC board. This should be quite straightforward if you use the PC board overlay diagram (Fig.2) and the internal photo as a guide.

Begin assembly by fitting the two wire links to the board. These are near IC2 in the centre and they are both 0.4" long (so you can use '0Ω' dummy resistors if you prefer). Also fit the three-way SIL header strip for LK1 at this time – it goes between IC2 and the relay location. Then fit the three 3-way terminal blocks, which go on the right-hand end of the board. The 2.5mm DC input socket can be fitted as well, down in the lower right-hand corner.

Now fit the resistors. Follow these with the smaller unpolarised capacitors, then the larger unpolarised and polarised capacitors. Make sure you fit the latter with the correct orientation, as shown in the overlay diagram. Note that there are two different 47µF electrolytics: one a low leakage (RBLL) type, usually in a case with an orange coloured sleeve, and the other a standard RB type in a black sleeved case. The low leakage unit goes near IC2 in the centre of the board, while the standard electro goes just to the left of REG1.

Next mount the three trimpots, the relay and the piezo buzzer. Note that the PC board provides multiple holes for the buzzer, to cope with different buzzer pin spacings.

The two pushbutton switches can be fitted after this, but you may need to slightly enlarge the PC board holes for these with a jeweller's file, to allow their lugs to pass through the board sufficiently for soldering.

Begin fitting the semiconductors by adding the various diodes, making sure you fit them in the correct locations and with the correct polarity. Then fit the three transistors, watching their orientation also.

The completed PC board mounted in a UB1 Jiffy Box. Note the hole and slot cut in the ends of the box – the hole (right) is for the plugpack mains adaptor, while the slot allows the wiring from the sensor unit and the wiring to external alarm/ controlled devices to enter the box.

Follow these with REG1, which is mounted horizontally with a 19mm U-shaped heatsink. Its three leads are bent downwards 6mm from the device body and soldered underneath.

The regulator body is held firmly down in contact with the heatsink using a 9mm long M3 machine screw with a star lockwasher and M3 nut.

The four DIL ICs are fitted next, making sure you fit each one the correct way around as shown in the overlay diagram.

As three of the ICs are CMOS, take the usual precautions to minimise the risk of electrostatic damage. Use an earthed soldering iron, and ideally earth yourself before picking up these devices. Also solder their supply pins to the PC board pads first, before soldering the other pins.

The final components to fit are the two LEDs, which are both 5mm types. The green LED fits in the LED1 position just below the relay, while the red LED fits in the LED2 position just above pushbutton S2.

Both mount vertically with the lower surface of their body 20mm above the board, so they will protrude through matching holes in the box front panel when it's assembled. They are also both orientated with their 'flat' side downwards, and their longer anode lead towards the top of the board.

Your Driveway Sentry board assembly should now be complete, and ready for testing.

Testing and setup

For the initial testing, there's no need to connect the remote sensor unit to the PC board assembly. Just connect a 330Ω resistor temporarily between terminals C1 and C2 at upper right on the board, as a passive 'stand in'.

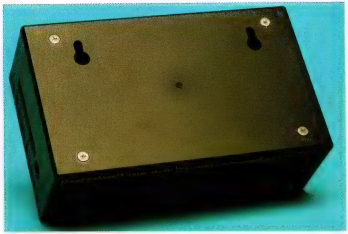
Then connect a plugpack or another source of 12V DC to CON1, the board's DC input connector at lower right.

If all is well, both LEDs should immediately light – LED1 because power is present and LED2 because the exit delay timing circuit has already begun counting. LED2 should remain on for about six minutes after power-up, just as it should do after you press button S2.

Next, connect a DMM to pin 8 of IC1, and measure the voltage. It should be between +2.5V and +3.0V. If it isn't inside this range, adjust trimpot VR1 until it is.

Now set trimpot VR3 to about mid-range and check that link LK1 is in the 'buzzer on' position. Also wait until LED2 is off, showing that the exit delay circuit has timed out. Then press Test button S1, which should make the relay operate and the buzzer sound.

If the buzzer operating time is not to your liking – ie, it's too short or too long – this can be changed quite easily by adjusting trimpot VR3. The adjust-



A couple of keyhole slots cut in the rear of the Jiffy Box makes it easy to mount the box on a wall. Naturally, these need to be cut before the PC board is installed in the box.

ment range is from about two seconds up to about 25 seconds.

The only other adjustment to be made to the Driveway Sentry is to vary the sensitivity of the sensor probe. This is done in much the same way as for the alarm duration, but by adjusting trimpot VR2. The adjustment must be done later though, when the system has been installed and the remote sensor unit connected. For the present, simply set VR2 to its midrange position.

Final assembly

The final step in building the Driveway Sentry is to fit the PC board assembly inside the main part of the box. It mounts via four 25mm long M3 tapped spacers, using four 9mm long M3 countersink head screws to fasten the spacers in the box, and four 9mm long M3 round head screws to attach the PC board.

When the board is mounted inside the box the pushbuttons will protrude through matching holes in the front panel, as will the two LEDs. The Probe Sensitivity (VR2) and Alarm Duration (VR3) trimpots can also be adjusted using a small screwdriver through their labelled adjustment holes.

A 10mm diameter hole in the right-hand end of the box allows the 12V DC cable to enter, while an adjacent rectangular slot allows entry of the various sensor unit and relay contact cables.

As you can see from the diagram of Fig.3, the rear of the box has two elongated holes to allow the completed control unit to be mounted on a wall using two 8G x 25mm self-tapping screws or similar. The screws should be fitted to the wall exactly 100mm apart, in horizontal alignment and screwed in with their heads only 2.5mm away from the wall.

Mount the control box in a position where it's unobtrusive, yet easy to access so you can press the Exit Delay button before leaving.

Locating the sensor

The remote sensor unit is housed in a sealed plastic tube 50mm in diameter and 370mm long. It's designed to be placed in a shallow trench alongside your driveway, so that it's out of sight while still being near any vehicles moving on the driveway. If there's a steel-framed gate at the driveway entrance, you can mount the remote sensing unit under the area where the gate is swung open, so it will detect the gate being moved as well as a moving vehicle.

Note that the remote sensing unit doesn't have to be mounted directly under the driveway, because it's quite sensitive. So there's no need to cut a trench in your concrete drive – just bury the sensor a small distance down in a lawn or garden bed alongside the drive.

The sensor is connected back to the control unit via its attached 30m long screened cable. The two inner wires of the cable connect to terminals C1 and C2, while the earthing screen connects to the centre 'G' terminal.

There's no need to dig a deep trench for the probe. It only needs to be about 100mm below the surface, where it should be hidden and protected from damage. The cable can be run back to the nearest building in a narrow trench of about the same depth.

Sensitivity adjustment

Once the sensor unit has been fitted in position and connected back to the control unit, you're ready to make the final adjustment: probe sensitivity. As explained earlier this can't be done using the Test button; it can only be done using a vehicle moving along the driveway, or someone opening or closing the gate or roller door for you.

Trimpot VR2 is turned clockwise to make the probe more sensitive, or anticlockwise to make it less sensitive. The best setting is where the probe reliably detects the smallest moving vehicle likely to enter or leave via the driveway, without being more sensitive than this.

If you simply adjust VR2 for maximum sensitivity (ie, fully clockwise), the Driveway Sentry may then be prone to giving 'false alarms' due to passing radio transmitters or mobile phones, or during electrical storms.

Putting it to use

When the Driveway Sentry is 'armed' and detects movement, it immediately produces an alarm sound from the buzzer and operates the relay. The relay contacts can be connected to another security system, so that when the relay operates this can initiate further action like triggering a loud siren, dialling a security firm, dialling your own mobile phone or whatever action you choose.

Please note that the relay contacts in the Driveway Sentry control box are NOT rated for switching 240V AC mains power.

So if you want to have the Sentry turn on high power floodlights or other mains-operated equipment when it detects vehicle or gate movement, you'll need to do this via a second external relay with mains-rated contacts (or a mains-rated solid state relay).

The Driveway Sentry's relay contacts can activate the external relay, to control the mains-powered lighting or equipment. Jaycar can supply a mains-rated solid state relay which would be quite suitable for this: the SY-4080, which can switch up to 3A at 240V (ie, 720W).

The main external connection options for the Driveway Sentry are illustrated in the diagram of Fig.3. As you can see it's very easy to hook the Sentry up to a larger security system, using a length of two-wire cable. One wire connects to either COM terminal on the control box, and the other wire to either the NO (normally open) or NC (normally closed) terminal in the

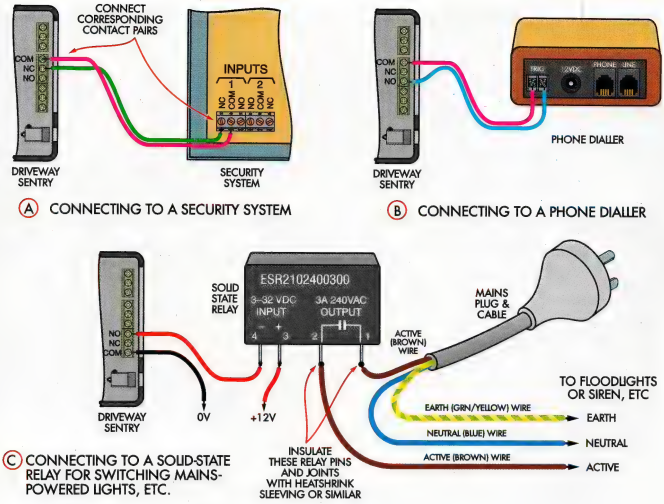


Fig. 3: connecting the Driveway Sentry to various external devices.

same group – depending on the security system input you connect it to at the other end.

If the security system input expects NO contacts, connect to the NO terminal; if it expects NC contacts, connect to the NC terminal.

Connecting the Sentry up to a phone dialler is just as easy. Again you simply use a two-wire cable, connecting it to a COM terminal and either of the matching NO or NC terminals depending on the type of contact action needed to trigger the dialler.

When you want to connect the Driveway Sentry so it can switch on external floodlights or a high-power siren powered by the mains, this can be done by connecting one of the Sentry's relay contact sets so that it can operate an SY-4080 solid state relay, or some other relay rated to switch 240V power.

As you can see, the positive input (control) terminal of the solid state relay is connected to the +12V supply, while its negative input is connected to the NO terminal of the Sentry contacts.

The COM terminal of the same set of contacts is then connected to 0V, so the solid state relay will be operated (turned on) when the Driveway Sentry detects a moving vehicle or gate.

The solid state relay's output connections are then used to switch 240V power to your siren or floodlights, etc. **SC**

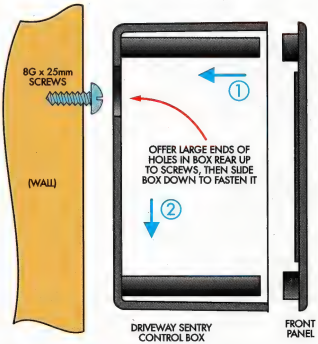


Fig.4: mounting the Driveway Sentry on a wall.

Control equipment from anywhere, any time, using SMS and an old Nokia mobile phone! – By Peter Smith

SMS Controller Pt.2

Last month, we described the circuit for the SMS Controller and gave the assembly details. This month, we tell you how to complete the circuit checking and describe how the unit is used.

Having carried out the power supply checks described last month in Part 1, the next step is to check out the serial interface and the microcontroller.

First, disconnect the power and insert IC1 and IC4 into their sockets. If the microcontroller needs to be programmed, then you should do that next. Refer to the "Microcontroller Programming" panel for more details on this.

Next, install jumper shunts on JP4–JP7. These should always be in place when the inputs (IN1 – IN4) are not connected, otherwise the micro's port pins will be "floating" in an indeterminate logic state.

Conversely, remove all jumper shunts from JP1–JP3 if installed earlier and apply power. The "Comms Error" LED (LED1) should illuminate, while all other LEDs (except the "Power" LED) should be off. This indicates that the micro cannot communicate with the phone, which of course isn't connected yet. However, it does tell us that the micro is doing what it should.

Note: the very first time you apply power, all red LEDs may come on for one second and then go out, with just the "Comms Error" LED remaining on. This sequence indicates that the micro has automatically erased its on-board EEPROM, ready for programming.

If you get a different result, the problem is most likely due to one or more pins of the micro having missed their sockets and bent underneath the chip.

If bent pins aren't the problem, then check out the oscillator circuit, consisting of crystal X1 and the two 22pF capacitors. If you have access to an oscilloscope, you can observe the operation of the oscillator on pin 18. In addition, check the voltage on the micro's RESET input (pin 9). This pin should measure close to +5V during normal operation, going low only during power up and power down.

The final step involves a quick checkout of the RS232 interface circuit. Measure the voltage between pin 2 of IC4 and ground and pin 6 of IC4 and

ground. You should get around +9.5V and -9.3V, respectively. These voltages are generated by the MAX232's internal charge pumps, in conjunction with the four 1µF capacitors.

If your board passes all the tests, you can now connect the data cable between your board and phone. Note that's it's a good idea to power off both devices when connecting and disconnecting this cable.

Suitable case

If desired, the completed module can be housed in a "UB1" size plastic jiffy box or similar, with a slot cut in the side of the box to accommodate the terminal block wiring.

The mobile phone must be positioned at least 50cm from the controller and associated wiring so that RF energy from its antenna doesn't interfere with the circuit operation. This is very important! If this separation cannot be attained in your application, then the controller must be housed in a metal case or shielded from the phone with a large metal plate.

Alternatively, both the 5110 & 6110 models support connection of an external antenna, which would allow good separation and improve signal strength in some areas.

On the 3310 model, the serial interface is accessible through a hole in the rear of the case, underneath the battery. The data cable is terminated with a plastic head assembly that includes a set of spring-loaded contacts as well as tabs to retain the battery that it partly displaces.

Operational basics

System operation is quite straightforward – when any of the digital inputs change state, the controller sends a pre-programmed SMS message to the nominated mobile number. Conversely, when you want to turn any of the outputs on or off, you send a message to the controller.

The messages used in both directions are programmed during the setup procedure. This allows the use of messages related to the task at hand. For example, you might want to assign the message "pump" to turn on the first output and "nopump" to turn it off. This means that you don't need to remember which output the pump is connected to or which state (high or low) is on or off.

The controller also recognises a number of unique messages, called "in-built commands", that can be sent from another mobile to program the system during setup, as well as modify system behaviour during normal operation. A summary of all these commands appears in Table.2. Before we look at how to set up the controller, let's look at each command in detail.

In-built commands

ACKON – this command forces the controller to respond to every message that it receives. If a received message is deemed valid, the controller responds with "OK". If a message is unknown, the response is "bad cmd".

ACKOFF – the opposite of **ACKON**. All further acknowledgments are disabled.

CHARGE{number} – this command allows you to modify the battery charging parameters, dependent on the model of phone in use.

For the 5110 & 6110, the {number} value defines the battery level at which the on-board charger is switched on. Only values between 0 and 4 are valid. A value of 4 instructs the controller to continually charge the phone and is therefore not recommended. The default level is 1.

For the 3210 & 3110, a timed charge/discharge scheme is used instead, as battery level information is not available to the controller. The {number} value defines the charge time in minutes, with the discharge time being fixed at 8 hours. Only values between 10 and 240 are valid. The default charge time is 40 minutes.

COUNT – Use this command to get the total number of messages sent and received by the controller, as well as the firmware version number. The returned message is in the format "r=nnnnn s=nnnnn v=nn.nn", where "r" and "s" are the total number of received and sent messages, respectively.

DIS{string} – in some situations, you may not want to be informed when a particular input changes state but still want to receive notification on the remaining inputs. An example of this might be when one sector of an alarm system is faulty and has been isolated. Using this command, you can disable notification on either or both states of any input.

For example, suppose a message of "SECTOR1ALARM" is programmed to be sent when an input goes low and a complementary message of "SECTOR1IDLE" is programmed to

The 3210 interface is also accessible under the rear cover but unlike the 3310, there's no need to remove the battery. Once in place, the connector and cable extend at right angles from the rear of the phone, which may make mounting awkward in some cases.

be sent when it returns high. To stop receiving these messages each time the input toggles, you could send the commands "**DISSECTOR1ALARM**" followed by "**DISSECTOR1IDLE**".

EN{string} – the opposite of **DIS{string}**, this command reinstates notification on the input and state designated by {string}.

LOGIN{pass} – essentially, this command tells the controller your current mobile phone number. You don't actually need to enter the number, as it's automatically gleaned from the incoming message. All messages are forwarded to the mobile phone that sent the last **LOGIN** command, which remains valid until another **LOGIN** or **LOGOUT** command is received.

If a password had been set, it must immediately follow the **LOGIN** command. An exception to this is in programming mode (JP3 in), where password checking is not performed.

LOGOUT – this command disables all outgoing messages. It's wise to send this command to the controller before you switch off your phone. If your phone's battery goes flat, or it's stolen or misplaced, use a friend's phone to first **LOGIN** and then **LOGOUT**. If you don't, a malfunctioning system could see you rack up a phone bill of astronomical proportions – a compelling reason to use only a prepaid plan for the phone connected to the controller (see panel in Pt.1)!

PASS{string} – sets a new password of 1-8 characters long. Passwords longer than 8 characters will elicit a "bad pass" response. The initial password is programmed during the setup procedure. Once set, it can be changed at any time but only from the currently logged-in phone (see **LOGIN** command).

Table 2: Command Summary

Command	Function
ACKON	Enable acknowledge messages
ACKOFF	Disable acknowledge messages
CHARGE{number}	Modify battery charge level (5110 & 6110) or charge time (3210 & 3310)
COUNT	Get SMS sent & received counters & firmware version number
DIS{string}	Disable state change messages on input defined by {string}
EN{string}	Enable state change messages on input defined by {string}
LOGIN	Enable message transmissions to your current mobile number
LOGOUT	Disable further message transmissions to your mobile
PASS{string}	Set new password to {string} (8 characters max.)
STAT	Get snapshot of digital inputs & open-collector outputs
The following commands are valid only in programming mode (JP3 in):	
IN{n}{L}{message}	Define the message the controller sends when input {n} goes low
IN{n}{H}{message}	Define the message the controller sends when input {n} goes high
OUT{n}{L}{message}	Define the message you send to drive output {n} low
OUT{n}{H}{message}	Define the message you send to drive output {n} high
OUT{n}{P}{message}	Define the message you send to pulse output {n} low

Here's a summary of the commands recognised by the controller. The curly braces are used here for clarity and should not be included in your messages.

A complete lineup of the supported models, from left to right: 5110, 6110, 3210 and 3310.

STAT – returns the current state of the digital input and open-collector output ports. The displayed format is "XXXX YYYYYYYY", where "X" and "Y" are "H" for logic high or "L" for logic low. The input port is displayed first, followed by the output port, with the most-significant bits (IN4 & OUT8) displayed first.

For the output port, an "H" (high) indicates the driver is switched off, whereas an "L" (low) indicates it in on. Note that external circuits may invert this logic.

A response from the **STAT** command looks like this: "HHLH HLHHHHHH". In this case, IN2 is low and IN1, IN3 & IN4 are high. On the output side, OUT7 in on (low) and all other drivers are off (high).

The following commands operate only in programming mode (JP3 in):

IN{n}{L}{message} – defines the message that will be sent by the controller when input {n} goes low. For example, suppose you've connected a switch to the first input (IN1), as shown in Fig.7(b). When the switch is closed, the input changes state from a logic high (+5V) to a logic low (0V). To receive the message "SWITCH CLOSED", the required command would be **IN1LSWITCH CLOSED**.

Of course, you can use any message you like, as long as it's no more than 16 characters long.

IN{n}{H}{message} – defines the message that will be sent by the controller when input {n} goes high. Using the previous example, to receive the message "SWITCH OPEN" when the first input (IN1) changes from a logic low to a logic high, the required command would be: **IN1HSWITCH OPEN**.

OUT{n}{L}{message} – defines the message that you send to the controller to drive output {n} low. For example, suppose you've connected a relay to OUT1, as shown in Fig.6(a). A low on this output grounds one end of the relay coil, switching it on. Assuming you want to use the message "RELAY ON", the required command would be **OUT1LRELAY ON**.

OUT{n}{H}{message} – defines the message that you send to the controller to drive output {n} high. From the previous example, to switch the relay off with the message "RELAY OFF", the required command would be **OUT1HRELAY OFF**.

OUT{n}{P}{message} – defines the message that you send to the controller to pulse output {n}. When the controller receives this message, the specified output will be driven low for one second, after which it returns high. Again from the previous examples, to pulse a relay on OUT1 using the message "PULSE RELAY", the required command would be **OUT1PPULSE RELAY**. It's important to note that when any output is defined as a "pulsed" output, you cannot also define it with the **OUT{n}{L}** or **OUT{n}{H}** commands.

Message syntax

Messages used in the "**IN**" and "**OUT**" commands can be composed from any characters in the available repertoire but the total length must be limited to 16 characters. Longer messages are automatically truncated. Spaces can be used in the body of messages but not adjacent to the command or password strings.

In addition, all user-defined messages, including the password, are *case sensitive*. This is a trap for the unwary; "PUMP ON" and "pump on" are not the same message! Inbuilt commands, on the other hand, are not case sensitive.

Finally, your messages must not start with the in-built command words **ACKON**, **ACKOFF**, **CHARGE**, **COUNT**, **DIS**, **EN**, **LOGIN**, **LOGOUT**, **PASS** or **STAT**.

Example setup

Let's look at a fictitious system setup so that you can see how it all works. The specifications for this system are as follows:

- All commands to the controller must be acknowledged.
- The system is to be password pro-

LED Indicators

Five LEDs are provided to indicate system status; four red (LED1 - LED4) and one green (LED5). The red LEDs indicate error conditions, so during normal operation, none of them should be on.

LED1 – Comms Error: when illuminated, this LED indicates a controller to phone communications problem. Normally, it comes on for 6 seconds after power on and then goes out. If it doesn't go out, check for problems with the controller to phone cable connection. In addition, check that phone security (PIN) has been disabled and that the phone comes up ready for use at power on.

LED2 – No Service: indicates that the phone is not registered within the mobile network (check signal strength) or that an outgoing message has been disallowed. The latter is typically due to an empty pre-paid account. Note that although your service provider will block outgoing messages when an account expires, most still allow inbound messages for a certain length of time.

LED3 – Send Error: when illuminated, the controller has failed to send one or more messages. This can be caused by a variety of problems, including mobile network overload, momentary signal dropout, an empty pre-paid account, phone malfunction or an intermittent controller to phone connection.

LED4 – Delete Error: indicates that the controller cannot delete a message from SIM memory. Cycle the phone power to correct this problem. If the error persists, then there may be a problem with the SIM card or phone.

LED5 – In Use: this LED comes on when you login to the system and goes out when you logout.

tected. The initial password will be "REDDWARF".

- A relay is connected to OUT1, as shown in Fig.6(a). The relay controls a pump motor.
- The relay is to be switched on by sending "PUMP ON" to the controller.
- The relay is to be switched off by sending "PUMP OFF" to the controller.
- A switch is connected to IN1, as shown in Fig.7(b). The switch detects water level in a tank.
- When the switch closes, we want to receive the message "TANK OVERFLOW".
- When the switch opens, we want to receive the message "LEVEL NORMAL".

We start in programming mode by installing a jumper on JP3 and powering up. After the "Comms Error" LED goes out (about 6 seconds), we can send our programming commands from a second mobile phone, as follows:

LOGIN (the green LED illuminates)
ACKON
PASSREDDWARF
OUT1LPUMP ON
OUT1HPUMP OFF
IN1LTANK OVERFLOW
IN1HLEVEL NORMAL

This completes the programming, so JP3 must now be removed, returning the system to operating mode. We can now control the pump by "SMSing" the following messages to the controller:

PUMP ON (switch the pump on)
PUMP OFF (switch the pump off)

If our imaginary tank overflows and the switch closes, we'll receive the message:

TANK OVERFLOW

When the level subsides and the switch opens, we'll receive the message:

LEVEL NORMAL

Now suppose we don't want to receive the "LEVEL NORMAL" message again. Instead, we only want to be informed when there is an overflow. We can disable the "LEVEL NORMAL" notification by sending:

DISLEVEL NORMAL

To later reinstate notification, we'd send:

ENLEVEL NORMAL

To change the password to "STARGATE" and disable acknowledgments, we could send:

PASSSTARGATE
ACKOFF

To log out of the system and prevent further messages being sent by the controller:

LOGOUT (the green LED goes out)

Finally, note that all future logins will require the current password, as follows:

LOGINSTARGATE

Each command is sent as a separate message. After the **ACKON** command, the controller will acknowledge all subsequent commands; you should wait until you receive these before sending the next command. Although you don't need acknowledgments turned on, it's the only way to be certain that the controller has received and processed your commands. This is much more important during normal operation, when you're far from the controller and can't see what's happening.

The password and all user-programmed messages are stored in the micro's EEPROM, so you only need to program the system once. The same goes for the output port state. If a power failure occurs, the last state will be automatically reinstated when power is restored.

You can reprogram the system at any time simply by repeating the steps outlined above. When you redefine a message for any input or output, the old message is automatically overwritten.

If you'd like to start from scratch, then all of the previously programmed messages can be deleted in one operation by erasing the microcontroller's EEPROM. This is achieved by powering off and installing a jumper on JP1. When you power up again, all four red LEDs come on to indicate that erasure is complete.

Note that this operation also wipes the password and all other parameters, including the "SMS sent" and "SMS received" counters.

Finally, you can erase just the password by powering off and installing a jumper on JP2. At the next power on, the password will be erased. Be sure to remove JP2 when done, otherwise the **PASS** command will have no effect!

Security

While it's not strictly necessary to program a password during setup and testing, we recommend that you do so before "going live". A password is an effective way of preventing someone else taking control of the module without your knowledge.

Microcontroller Programming

If you're building this project from a kit, then the microcontroller (IC1) will have been programmed and you can ignore the following information. Alternatively, if you've sourced all the components separately, then you'll need to program the microcontroller yourself.

A 10-way header (CON5) has been included on the PC board for connection to an "in-system" type programmer. We described a suitable low-cost programmer in the October 2001 edition of SILICON CHIP. Kits for the programmer are currently available from Altronics (Cat. K-2885), on the web at **www.altronics.com.au**.

Note that if you are using this particular programmer, the "Atmel AVR ISP" software described in the instructions is no longer available. A suitable alternative, named "PonyProg", is available free from **www.lancos.com**. Set up PonyProg for the "AVR ISP (STK200/300)" parallel port interface as described in the included documentation for compatibility with the programmer.

Some readers may also be familiar with the more recent "AVR ISP Serial Programmer", described in the October 2002 edition. This newer programmer will do the same job but connects to your PC via a serial (rather than parallel) port. Kits for this programmer are available from Jaycar Electronics (Cat. KC-5340) – see **www.jaycar.com.au**.

As published, the AVR ISP Serial Programmer can successfully program the AT90S8515 microcontroller. However, to program many of the newer generation micros, including the ATMega8515, the code in the programmer's on-board micro must first be updated. An update is available from the SILICON CHIP web-site.

Once you have a suitable programmer, together with the necessary cables and Windows software to drive it, all you need to complete the job is a copy of the microcontroller program for the SMS Controller. This can be downloaded from our web site in a file named "SMS.ZIP".

"SMS.ZIP" contains the file "SMS.HEX", which needs to be programmed into the micro's program (FLASH) memory. Just follow the instructions provided with the programmer and software to complete the task.

Fuse bits

We've specified either AT90S8515-8 or ATMega8515-16 microcontrollers for this project. Although it has many improvements over its predecessor, the ATMega8515 is a pin-for-pin replacement for the AT90S8515. In fact, we've tested this project with both devices to ensure compatibility.

The only additional requirement when using the ATMega8515 is to ensure that the fuse bits are correctly programmed (see Figs.10 & 11). The default fuse settings in the AT90S8515 are OK and should not be altered.

The AT90S8515 & ATMega8515 micros are both stocked by Jaycar. The ATMega8515 is also available from Dontronics, on the web at **www.dontronics.com**.

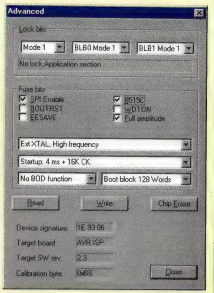


Fig.10: if you're programming your own ATMega8515 micro, you must also program the fuse bits. Here's how they're configured in AVR Prog, as used with the AVR ISP Serial Programmer. Once you've set all of the options exactly as shown, click on the "Write" button.

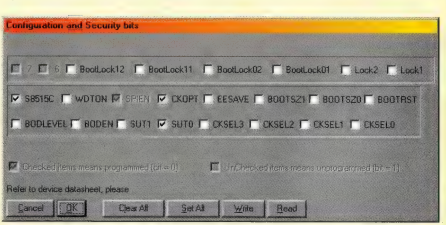


Fig.11: the parallel port programmer (October 2001) uses PonyProg, which has an entirely different fuse configuration menu. Again, copy this example and hit the "Write" button. Don't be tempted to experiment with different fuse settings unless you know exactly what you're doing, as certain combinations can render the micro inoperable!

Once you've successfully logged in, the controller will only accept messages from your mobile phone number. Messages from all other numbers are simply ignored. An exception to this is the **LOGIN** command itself, which can be issued from any mobile number at any time, regardless of whether you're already logged in or not. This allows you to regain control of the system using a second phone should your current phone be lost or stolen. **SC**

Credits

Thanks go to the gnokii team, who kindly published details of their work with the Nokia serial bus protocols. You'll find their web site at: **www.gnokii.org**.

CIRCUIT NOTEBOOK

Interesting circuit ideas which we have checked but not built and tested. Contributions from readers are welcome and will be paid for at standard rates.

Low coolant alarm for Falcon EF & EL

Many vehicles have some sort of coolant high-temperature warning gauge or lamp. However, a water level switch is the best detector of sudden coolant loss, if catastrophic engine damage is to be avoided.

Ford Falcon GLi EF and EL models have provision for installation of a low-coolant sensor in the surge tank. The Fairmont and Fairlane, which have the sensor as standard, operate an instrument panel warning light via the instrumentation computer. However, to retrofit this to other models, a simple electronic interface is required.

The proprietary Ford magnetic level switch (Fig.2) measures 180Ω at correct (high) water level and 1380Ω at low water. These resistances are too high to operate typical automobile 85Ω relay coils, which draw about 150mA at 13.8V DC.

To solve this problem, a simple transistor circuit can be used to buffer the output from the level switch, as shown in Fig.1.

D1 ensures that the circuit does not prematurely trigger with high battery voltages, while LED1 provides low water indication. The latter should be sufficiently bright under most daylight conditions. Q1 & Q2 can be any general-purpose small-signal switching transistors.

Modern vehicles perform a self-check of the warning lights when the ignition is first switched on. Ideally, a fail-safe test of the water level circuit should also occur but in this case, the magnetic switch is always closed. That's the reason for push-button "test" switch S2 – it turns Q1, Q2 and LED 1 on when pressed to show that the circuit is working. It's not fail-safe but satisfactory if you remember to occasionally press the switch.

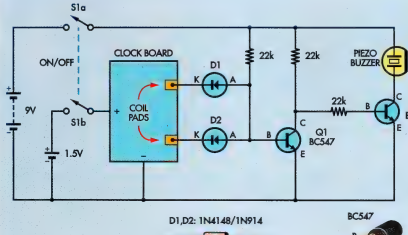
All components except the LED and S2 can be built on a tag strip, which can then be mounted behind the clock panel. The panel facia is drilled to take a suitable rubber grommet or bezel to accommodate the LED. The circuit operates from 10-15V, which is taken from the fused side of the ignition circuit.

The Ford sensor kit includes an "O" ring seal and locking nut. Before removing the proprietary electrical connector, thoroughly test the sensor and circuit by moving the float up and down. This is important, as Ford will not refund a damaged or modified unit!

Obviously, the surge tank has to be drained below the threaded mounting point and a hole cut through this existing mount with a hole saw. Take care not to damage the threads. Retrieve all swarf to prevent pipe blockages. Refill with correct coolant and check for leaks under normal engine working conditions.

Warning: header and surge tanks operate at pressures in excess of 100kpa (15psi) and up to 125°C using 33% Glycol coolant!

Robert Gott,
Toowoomba, Qld. ($30)



One-second darkroom ticker

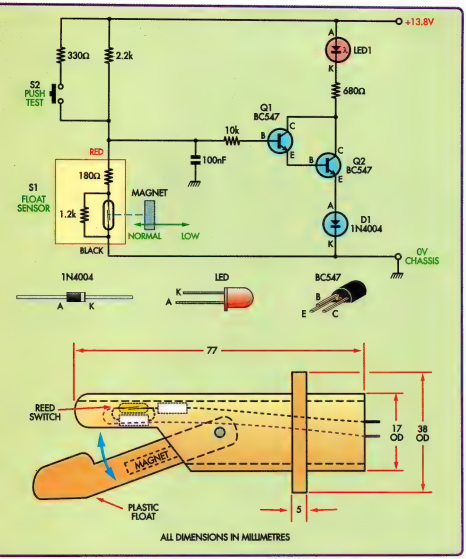
An audible 1-second ticker is easier to use in the darkroom than a visible clock. It enables the photographer to watch what he or she is doing when making test strips or the final print, rather than watching the clock. This device provides those ticks and is easily constructed.

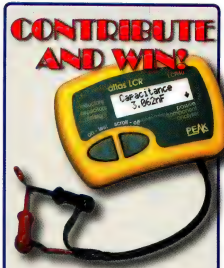
Begin by extracting the circuit board from a discarded quartz clock and disconnect the coil. The accompanying circuit shown at left can then be connected to the coil pads.

The coil outputs are normally "high", pulsing "low" for 30ms every two seconds in an alternate fashion. The two diodes (D1 & D2) perform an "OR" function, pulling the base of Q1 low briefly once every second. Each low pulse switches Q1 off and Q2 on, briefly sounding the piezo buzzer.

And there's your 1-second ticker!

A. J. Lowe,
Bardon, Qld. ($30)





We pay good money for each of the "Circuit Notebook" contributions published in SILICON CHIP. But now there's an even better reason to send in your circuit idea: each month, the best contribution published will win a superb Peak Atlas LCR Meter valued at $195.00. So don't keep that brilliant circuit secret any more: sketch it out, write a brief description and send it to SILICON CHIP and you could be a winner! You can either email your idea to silchip@siliconchip.com.au or post is to PO Box 139, Collaroy, NSW 2097.

Simpler PC power-up

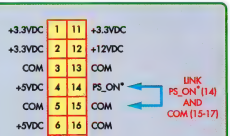
Here is an even simpler alternative to the auto power-up of ATX PCs mentioned in the June 2004 issue; it requires no parts at all! In ATX PCs, the motherboard controls the power supply by switching the "PS_ON" signal high (+5V) to enter standby mode or low (0V) for normal operation. The "PS_ON" signal appears on pin 14 of the motherboard's power supply connector, as shown on the accompanying diagram.

To prevent the power supply from entering standby mode, the "PS_ON" signal can be strapped permanently low. This can be achieved by cutting the track leading to pin 14 of the connector on the motherboard. A wire link can then be soldered between pin 14 and pin 15 ("COM") of the connector.

If you don't want to modify your motherboard, you may be able to remove the respective pin from the rear of the power supply connector housing and splice it into one of the "COM" return wires.

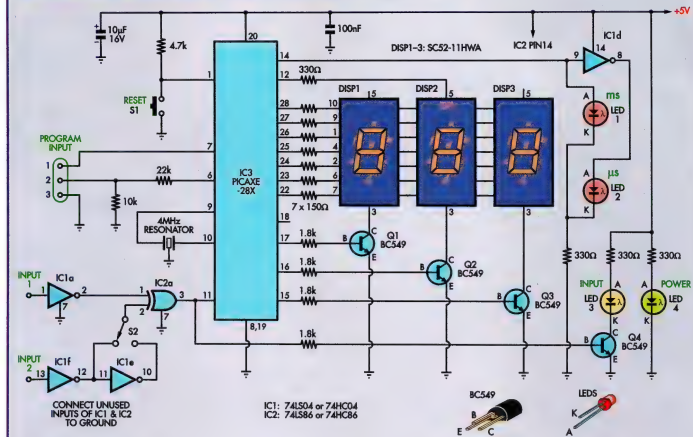
Obviously, this will disable standby functionality completely, including front-panel power button control. This is great for auto power-up of servers on resumption of power after a UPS low-battery shutdown. I have my file server in the roof at home and this saves getting the ladder out after the all too frequent power failures.

Before getting the tools out, it pays to check that your motherboard does not already have provision for automatic power-up when mains power is applied. This might be in the form



of a jumper or settings in the BIOS, as detailed in "Mailbag" on page 4 of the September 2004 issue.

Tarek Helland, via e-mail. ($20)



Micro timer with LED readout

This circuit measures short duration events ranging from 10µs to 655ms, in 10µs increments. It has two logic-level (TTL) inputs that can be used to measure the high or low time of a pulse, or the time difference between two pulses.

Applications include measuring the execution time of a microcontroller program, the time difference between output signals in a circuit, or the changeover time in switches & relays. It is particularly useful for measuring one-off events that can be difficult to catch on a scope.

The circuit uses three 7-segment common-cathode LED displays for the readout. Two individual LEDs indicate whether the reading is in microseconds or milliseconds, with the software automatically selecting the correct range.

The circuit requires +5V at approx. 25mA in standby and 100mA with all 18 segments turned on. In many cases, this can be sourced from the circuit under test.

A PICAXE microcontroller measures the length of high-going pulses applied to pin 11. This pin is driven by the output of a 74LS86 XOR gate (IC2a). Two 74LS04 inverters (IC1a & IC1f) feed the XOR gate and act as buffers for the two inputs. Additionally, one of the inputs had a second inverter that can be switched in or out of the circuit with S2.

Timing starts as soon as the signals applied to the two inputs differ, generating a high-going pulse on pin 11 of the micro. When both inputs again match, timing stops and the pulse length is displayed. Timing is also terminated if the pulse width exceeds the maximum measurement period (0.65s).

When only one input is required, the signal should be applied to input 2 and input 1 grounded. LED3 indicates the state of the signal on the PICAXE input. Prior to the measurement, it should be off. If not, toggle switch S2 to invert the signal. The switch therefore allows the measurement of both high and low-going pulses.

Referring now to the program listing, the PICAXE **pulsin** command is used to measure the pulse high time, which is stored in the variable word *w5*. This part of the program loops until a value greater than zero is detected.

Measurement is in 10µs steps, so when the number 1 is returned, it corresponds to a time of 10µs. Be aware that a 43µs pulse will be read as a 4 and displayed as 40µs. This loss of precision only occurs in measurements under 1ms. Measurements over 1ms are correct.

When a pulse is detected, *w5* is tested to see if it is greater than 99 (990µs). If not, simple division splits the first 2 digits into *b1* and *b2*. The "µs" indicator (LED2) is then turned on by setting pin 13 (portc 2) low.

If the value is greater than 99, the software jumps to the "ms:" section. First, the "ms" indicator (LED1) is

turned on by setting pin 13 (portc 2) high. Next, a check is made to see if *w5* is less than 99ms. If so, there must be a decimal place, so the decimal point is turned on (portc 3). Division of the returned value occurs, with the results in *b1*, *b2* and *b3*.

If *w5* is greater that 99ms, then the "high_ms:" routine is executed. The value in *w5* is divided by 1000, placed in *b0*, and the first two digits divided into *b1* and *b2*. To get the third digit, *b0* is multiplied by 1000 and placed in *w4*. Again, the results are returned in variables *b1-b3*.

Finally, the results from the "decode:", "ms:" or "high_ms:" sections are displayed on the readout by the "display:" routine. This part of the program loops back on itself, so that the last measurement is held on the display until the reset switch (S1) is pressed.

Seven of the PICAXE-18X's dedicated output pins (out1 - out7) are used to drive the segments in each of the displays via 150Ω current-limiting resistors. The value for each digit is stored in the variables *b1*, *b2* & *b3*, as described above. Using the **lookup** command, the program converts these values into a binary pattern needed to illuminate the correct segments. The result is then written to the output port using the pins command.

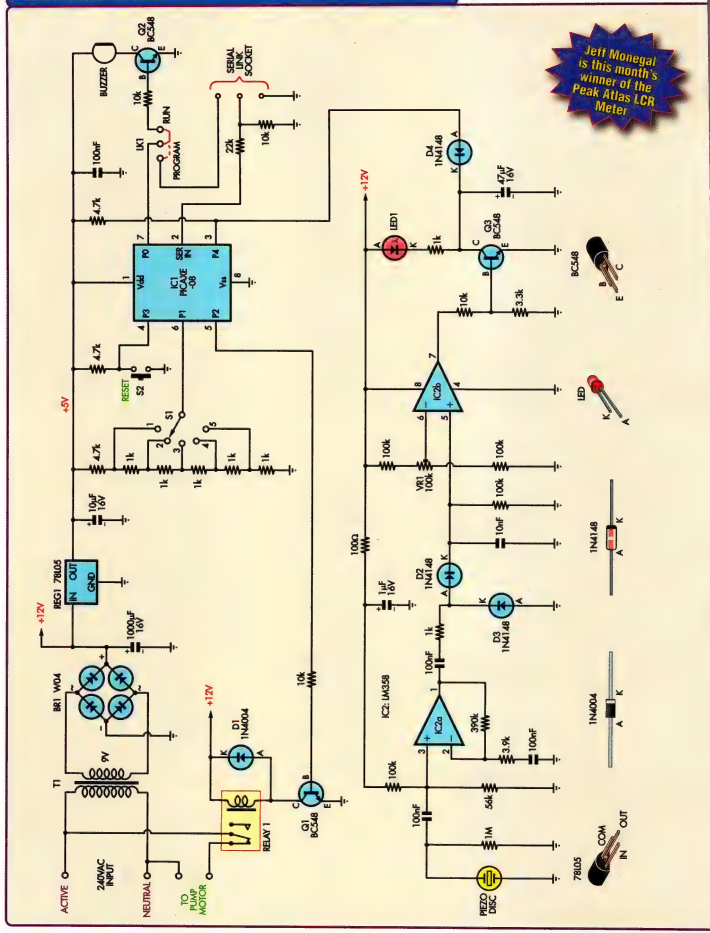
As the anode pins of all three displays share the same seven output lines, a multiplexing technique is used to sequentially enable each display for 3-5ms at a time. This is achieved in the circuit by turning on transistors Q1, Q2 & Q3 in turn, grounding the common-cathode pins of the displays. Three portc output pins drive the transistors via 1.8kΩ biasing resistors.

A secondary use for this circuit and software is as the basis for any project where 7-segment readouts need to be driven by a PICAXE. This is achieved simply by omitting the input circuit and indicator LEDs. Also, delete the program lines prior to the "display: " routine.

In its present form, the "display: " routine will drive three 7-segment displays, though a fourth is easily added.

Brett Cupitt
Ashfield, NSW. ($60)

```
'Pulse length measurement and display for PICAXE-28X
'Registers,b10,b11 (w5) = pulse length
'b5 = 7 segment display, segment config data
'b0 = temporary/working register
'b1-b4 = digits to be displayed; b1=MSB, b3=LSB

init:
  let w5=0                      'clear w5 value

measure:                        'pulse length measure routine
  pulsin 0,1,w5                 'read pulse length on input 0 into w5
  if w5>0 then decode:          'if we have a reading, process it
  goto measure:                 'loop if no value

decode:                         'are we measuring us or ms
  if w5>99 then ms:             'if its a value in ms, go to ms section
  low portc 2                   'OK, its a value in us, turn us LED on
  let b1=w5/10                  'MSB
  let b2=w5//10                 '2nd digit
  let b3=0                      'LSB
  goto display:                 'now display it

ms:
  high portc 2                  'turn ms LED on
  if w5>9999 then high_ms       'is it a big or little number?
  high portc 3                  'decimal point on
  let b0=w5/100                 'get the 1st 2 digits
  let b1=b0/10                  'MSB
  let b2=b0//10                 '2nd
  let b3=w5//100/10             'LSB
  goto display:                 'now display it

high_ms:
  let b0=w5/1000                'get 1st 2 digits
  let b1=b0/10                  'get MSB
  let b2=b0//10                 'get 2nd digit
  let w4=b0*1000                'calculate the 1000's
  let w4=w5-w4                  'take these away from the total
  let b3=w4/100                 'the hundreds are left, get the MSB

display:                        'start of data display routine
  lookup b3,($7e,$0C,$B6,$9E,$CC,$DA,$FA,$0E,$FE,$DE),b5
  low portc 6                   'turn off MSB
  let pins=b5                   'output 7 segment display sequence
  high portc 4                  'turn on LSB
  pause 6                       'hold for 6ms

  lookup b2,($7e,$0C,$B6,$9E,$CC,$DA,$FA,$0E,$FE,$DE),b5
  low portc 4                   'clear LSB
  let pins=b5                   'output 7 segment display sequence
  high portc 5                  'turn on 2nd digit
  pause 4                       'hold for 4ms

  lookup b1,($7e,$0C,$B6,$9E,$CC,$DA,$FA,$0E,$FE,$DE),b5
  low portc 5                   'turn off 2nd digit
  if b1=0 then display:         'blank leading zeroes
  let pins=b5                   'output 7 segment display sequence
  high portc 6                  'turn on MSB
  pause 4                       'hold for 4ms
  goto display:                 'cycle
```


Jeff Monegal is this month's winner of the Peak Atlas LCR Meter
ACTIVE
NEUTRAL
240VAC INPUT
TO PUMP MOTOR
T1
9V
BR1 W04
REG1 78L05
IN
OUT
GND
+12V
1000µF 16V
10µF 16V
+5V
4.7k
1k
S1
S2
RESET
IC1 PICAXE -08
Vdd
Vss
P0
P1
P2
P3
P4
SER IN
LK1
PROGRAM
RUN
10k
22k
100nF
BUZZER
Q2 BC548
SERIAL LINK SOCKET
D1 1N4004
RELAY 1
Q1 BC548
D4 1N4148
47µF 16V
LED1
Q3 BC548
3.3k
IC2b
VR1 100k
100k
10nF
100Ω
1µF 16V
D2 1N4148
D3 1N4148
IC2: LM358
IC2a
390k
3.9k
56k
1M
PIEZO DISC
78L05
COM
OUT
IN
BC548
LED
1N4148
1N4004

Water pump monitor

This circuit is designed to stop a fresh water pump from running too long. When you live on the land, your water supply is stored in tanks and you tend to be more vigilant about water use. If, for example, a pipe ruptures or a tap is left open, loss of pressure in the line will cause the pump to start. If the owner does not know this or is away, then the pump could empty a full tank within a short time.

The project was conceived when a water pipe burst while I was away for the weekend. Luckily, a neighbour noticed the water spout and shut the pump off. If the tank had emptied that would have been bad enough but the cost of a burnt-out pump would have been much worse.

Another use is as a timer for watering the garden. Pick a time and turn on the tap. This unit will shut off the pump and sound an alarm at the end of the selected time. Perhaps you have teenagers that like to take long showers. Set the time to 10 minutes and watch them complain!

Five different times are available and these can be altered to suit your needs by editing the microcontroller program. To reset the pump after a time out, simply press the reset button for two seconds.

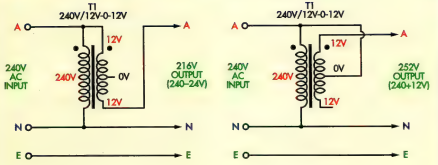
The circuit works by detecting the vibrations from the pump while it is running. When the pump starts, a timer is started and after the set time has elapsed the pump will be shut off and an alarm sounded.

If the pump you have is quite powerful, pressure in the line can build up high enough to stop the pump. If a tap is still open, the pump will start again when the pressure drops. The software takes all this into consideration and is not fooled by the pump switching on and off. The pump must be off for more than 20 seconds for the program to reset the timer and think that the tap has been closed.

A PICAXE-08 microcontroller runs the whole show. It knows the pump is running because a piezo sensor is physically mounted on the pump. Motor vibrations excite the piezo sensor, generating a small AC voltage across its terminals. This signal is amplified

continued next page

```
' Water Pump Controller  v1.00
' PICAXE-08

start:
  symbol cntr = b2
  symbol time = w0
  symbol pump = 2
  symbol bell = 0
  symbol reset = pin3

begin:
  low pump                          'make sure pump is enabled
  cntr = 0                          'clear the "pump off time" counter

main_lp:
  if pin4 = 0 then run              'if pin 4 goes low the pump is running
  goto main_lp

run:
  pause 2000                        'debounce the pump for 2 seconds
  if pin4 = 1 then main_lp          'if pin4 = 1 then false start
  gosub read_time                   'read the "time set switch"

time_loop:
  time = time - 1
  if time = 0 then alarm
  if pin4 = 1 then is_pump_stopped  'pump off for > 20 secs?
  cntr = 0
  goto all_ok

is_pump_stopped:
  pause 100                         'pump debounce delay
  if pin4 = 0 then all_ok           'if pump still on the continue
  cntr = cntr + 1                   'count seconds pump is off
  if cntr = 20 then begin           'if > 20 secs put system in standby

all_ok:
  pause 1000
  goto time_loop

alarm:
  high pump                         'disable the pump

loop:
  pulsout bell,50                   'sound the buzzer
  pause 300
  pulsout bell,50                   'sound the buzzer again
  if reset = 0 then begin           'if reset switch pressed, reset system
  pause 3000
  goto loop

'This routine looks at the select time switch (S1)
'and loads required value into "time" variable

read_time:
  readadc 1,b0
  if b0 > 30 then four
  time = 5400
  return

four:
  if b0 > 55 then three
  time = 2700
  return

three:
  if b0 > 83 then two
  time = 1800
  return

two:
  if b0 > 110 then one
  time = 1200
  return

one:
  time = 900
  return
```



Reducing the effective mains voltage

Would you like to use a particular power transformer in an amplifier or some other project you're building but its secondary voltage is just a little too high? Or perhaps you have an imported piece of equipment with a power transformer rated for a mains voltage of 220V, so it gets too hot and bothered running from 240V? It's easy to solve these and similar problems by using a standard off-the-shelf low voltage transformer as a DIY autotransformer, to reduce the effective mains voltage fed to your equipment.

The idea is to connect some or all of the secondary winding of the extra transformer in series with the mains voltage fed to your equipment, with its polarity chosen so that its voltage subtracts from the 240V input (see circuit A). Here a standard transformer with a 12V-0-12V secondary winding is connected with the full secondary in series with the active output lead, so the effective output voltage becomes 240V - 24V, or 216V. This exact arrangement would be fine for any application where you need to reduce the mains voltage for equipment by about 10%, to make its power transformer run cooler or to bring its secondary voltage down so your power supply electros can be run within their ratings.

Of course, if you don't need to reduce the mains voltage by a full 10%, you could use only half the secondary winding connected in series with the active output lead. This will give an output voltage of 240V - 12V, or 228V (a reduction of 5%). Or you could use a transformer with a multi-tapped secondary voltage, which would allow you to reduce the output voltage in steps of 1.5V or 3V.

When you're choosing the transformer for this kind of use, make sure that its secondary winding is rated to handle the full-load primary current of the main power transformer in the equipment it's to be used with. So if your amplifier has a 300VA power transformer, for example, its full-load primary current will be around 1.25A (300/240V). In this case, you'd pick a mains-reduction transformer with a secondary winding rated to handle 1.5A or 2A and with a voltage equal (or close) to the mains voltage reduction you want.

Can you use the same kind of transformer to step up the effective mains voltage by 10% or so? Yes, simply by connecting its secondary winding (or a part of it) in series with the active mains lead with its polarity reversed, so the secondary voltage adds to the output instead of subtracting. This is illustrated in circuit B, where the same transformer is connected with half its secondary in series, to add 12V to the mains input and deliver an output of 252V.

Note that because both of these circuit configurations use the additional transformer as an autotransformer, they do not provide any isolation. For safety reasons, fit the transformer in a sturdy metal box, and connect both the box and the transformer frame to mains earth.

SILICON CHIP.

Water pump monitor: continued from page 85

by op amp IC2a, which is set for a gain of about 85. From here, the signal is rectified by a diode pump circuit and then compared with the voltage on the wiper of VR1 by op amp IC2b. When the voltage on pin 5 exceeds that on pin 6, the output of the op amp swings high, turning on Q3. This turns on the LED and pulls pin 3 of the micro (IC1) to a logic low level via D4.

Next, the micro reads the voltage on pin 6 as selected by S1. As this pin is an ADC (analog-to-digital converter) input, the voltage read will vary according to the position of the switch.

The result is used by the program to select one of five times from a look-up table stored in memory.

The pump "run" timer now starts and if the signal on pin 3 remains low (pump on) for longer than the selected time period, the micro drives pin 7 high to switch on Q2, sounding the alarm. More importantly, it also drives pin 5 high, switching on Q1 and energising the relay, which in turn opens the normally-closed contacts to disconnect the pump motor.

To reset the pump, just press the reset button (S2). The pump will now start again because there will be no pressure in the line. Once pressure has built up again the pump will stop, assuming you have turned off the offending tap or fixed the fault with the lines.

The five selectable times are determined by the number stored in the "time" variable. Each unit equals one second. For example, to set a time of 30 minutes, the number 1800 would be used. As it stands, the program has been set for 90, 45, 30, 20 and 15 minutes.

When mounting the piezo sensor, make sure that it is physically touching the pump. Most pumps have removable end plates. The disc can be inserted between the end plate and the pump body.

Any single-plate piezo transducer can be used for the job. Many piezo transducers come with a plastic surround. Remove the disc by prising it out of the surround before mounting. Oatley Electronics sells discs that are ideal for this application.

Jeff Monegal,
North Maclean, Qld.

PRODUCT SHOWCASE

New look "ergonomic" digital multimeters

Tenma have released a new range of ergonomic and modern-looking digital multimeters.

The range includes the 72-7720 (pictured), a full function multimeter offering a variety of ranges for every service application and meeting 1000V CAT II standards.

A rugged overmoulded housing stands up to the daily rigors of field service use and large backlit LCD display is easily read from several feet away.

Measurements include AC/DC voltage, AC/DC current, resistance and capacitance. The 3-1/2 digit, 1999-count display features 22mm digits for easy at-a-glance reading.

Additional features include continuity buzzer, data hold, full icon display, sleep mode and low battery display.

Standard test leads are included, along with separate short leads for accurate capacitance checking, a 9V battery and owners manual.

The multimeter is distributed by Farnell InOne (order code 743-0582).

Contact:
Farnell InOne
PMB 6, Chester Hill NSW 2162
Tel: 1300 361 005 (NZ 0800 90 80 80)
Website: www.farnellinone.com

World's first large-screen OLED display

Seiko Epson Corporation has used its original inkjet printing technology to successfully develop the world's first large-screen (40-inch) full-color organic light-emitting diode (OLED) display prototype.

Self-luminescent OLED displays, which offer outstanding viewing characteristics, including high contrast, wide viewing angle and fast response times, are widely seen as the leading candidate for the next generation of thin, lightweight displays.

One of the major obstacles to their realisation, however, has been the difficulty of forming organic layers on large-sized TFT (thin film transistor) substrates.

Epson has been actively working to develop and commercialise next-generation OLED displays. The company, a leader in inkjet printers, has developed an original inkjet process for depositing organic layers on large-size TFT substrates.

By establishing an OLED display manufacturing system and process that can handle oversized substrates, Epson has beaten a path to large-size OLED displays, as well as to lower cost small and medium-sized panels cut from larger TFT substrates.

Epson believes that the characteristics of OLED displays make them the ideal device for entertainment applications, whether in equipment for the road or living room.

The company is gearing up towards commerial production in 2007.

Contact:
Seiko Epson Corp
Locked Bag 2238 North Ryde BC1670
Tel: (02) 8899 3666 **Fax:**(02) 8899 3777
Website: www.epson.co.jp

Hard-to-find wireless LAN adapters/pigtails

Microgram has a range of normally-hard-to-get adapters and pigtails for wireless LAN applications. Included are:

Reverse SMA to type N female adapter (Cat No. 15154-14, rrp $27.00). Connects the majority of access points directly to low-loss (LMR-400) antenna cable

I.Pex MHF to N female pigtail (Cat No. 9191-14; rrp $35.00) These connects a mini PCI 802.11a/g card to an N female connector. Consists of an I.PEX MHF series plug, also known as U.FL (Hirose), to N female bulkhead mount.

Male N to reverse F MMCX pigtail (Cat No. 9219-14; rrp $30.00) – connects 200mw PCMCIA wLAN cards to low loss (LMR-400) antenna cable.

Wireless RF adapter set (Cat No. 9211-14 RF; rrp $239). Need an RF adapter? Make the one you need. There are two by 16 different connectors that can be assembled in any combination.

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Website: www.microgram.com.au

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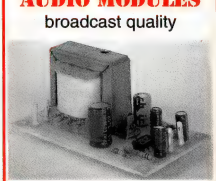

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Preamp kit, sinewave inverter from DSE

Dick Smith Electronics have submitted their version of the Balanced Mic Preamp with 3-band equaliser (August 04 SILICON CHIP).

The kit is quite different in appearance from that published – it's housed in a black instrument case, for example – but is electrically identical.

The case is silk-screened and prepunched front and back, making assembly very simple and giving a very professional result.

The kit (K7219) retails for $59.87

The other item of note is a 300W True Sinewave Inverter (M5113) which, as its name suggests, supplies 230V AC, 50Hz from a 12V DC source.

Many cheap inverters provide chopped or modified DC output – and many electronic devices do not like this one little bit! The output of this inverter however is a true sinewave (very close to that of a normal mains supply). It will therefore operate most 240V equipment (within its 300W output limit). It has two standard 240V outlets on the front panel.

The high-efficiency inverter has overload protection and low battery warning.

It retails for $294.00 and is available from all DSE stores, PowerHouse stores and via on-line and mail orders.

Contact:
Dick Smith Electronics (all stores)
Reply Paid 500, PO Box 500,
Regents Park DC NSW 2143.
Tel: 1300 366 644 **Fax**: (02) 9642 9155
Website: www.dse.com.au

Special offer on Altronics pro-quality cans

Altronics distributors were so happy with the quality and performance of their new CD-90 studio quality headphones they sent us a pair to try out . . . and they do live up to their claims.

As well as being exceptional performers, suitable for use as studio monitors or high fidelity music appreciation, these lightweight 'phones are extremely comfortable, with earpieces that can swivel through both axes.

With Neodymium magnets in the 50mm drivers, they have a frequency response of 100Hz to 30kHz with a rated SPL of 100dB.

Nominal impedance is 32Ω.

For November and December, Altronics stores and mail/online orders are offering these headphones (Cat C9014) at a special price for SILICON CHIP readers: $90.00 instead of the usual $99.00. Don't forget to tell them you saw the 'phones in SILICON CHIP!

Contact:
Altronics Distributors
Box 8350, Perth Business Centre 6849
Tel: 1300 797 007 **Fax**: (08) 9428 2187
Website: www.altronics.com.au

European-styled LCD TVs from Baumann Meyer

It's not a name you'd instantly recognise but for the past few years Baumann Meyer has been building a reputation as a supplier of stylish and technologically advanced LCD televisions to the Australian market.

The company has now released what is arguably the most stylish and distinctively European looking 66cm (26inch) widescreen (1280 x 768 pixels) LCD television - the DT-2600. In airbrushed aluminium surrounds, the new Baumann Meyer DT-2600 LCD television features a 96 channel multizone analog tuner, plus matching SD set top box to receive the best in both analog and digital transmissions.

The DT-2600 has a 500:1 contrast ratio and enhanced brightness (450cd) that translates into picture detail and colour brilliance that makes for the most realistic and natural picture colour available.

The built-in 12W stereo amplifier can be set for stereo, pseudo stereo and surround via its 2-channel output. Video features include, Teletext, Digital Action Freeze, Picture-in-Picture mode, and PC compatibility. For connection to the latest in a/v equipment, the DT-2600 offers RGB via SCART, Component, S-Video, Composite video/audio and RF.

With its centre of gravity strategically centred to offer a very stable footprint, it's suitable for coffee table and side table placement as well as wall mounted.

Available at selected retailers, the DT-2600 has a recommended retail price of $3999 (includes digital Set Top Box).

The DT-2600 is just one in the range of Baumann Meyer's lifestyle LCD TVs. Other models include the 80cm (32 inch) widescreen at $4999 for release in October, the 51cm (20 inch) WTP-20B2 at $1850, and the 38cm (15 inch) WTP-15B2 at $950.

Contact:
Baumann Meyer
PO Box 594, Balgowlah NSW 2093
Tel: 1300 656 369 **Fax**: (02) 9977 6007
Website: www.baumannmeyer.com.au

SILICON CHIP WebLINK

How many times have you wanted to access a company's website but cannot remember their site name? Here's an exciting new concept from SILICON CHIP. You can access any of these organisations instantly by going to the SILICON CHIP website (siliconchip.com.au), clicking on **WebLINK** and then on the website graphic of the company you're looking for. It's that simple. No longer do you have to wade through search engines or look through pages of indexes – just point'n'click and the site you want will open!

Your company or business can be a part of SILICON CHIP's **WebLINK**. For one fee, we'll run you entry a printed entry each month on the SILICON CHIP **WebLINK** page with your home page graphic, company name, phone, fax and site details plus up to 50 words of description – and this is repeated on the **WebLINK** page on the SILICON CHIP website with the link all ready active. Get those extra hits on your site from the right people in the electronics industry – the people who make decisions to buy your products. For information, call BENEDICTUS SMITH Pty Ltd today on (02) 9211 0702

JED designs and manufactures a range of single board computers (based on Wilke Tiger and Atmel AVR), as well as LCD displays and analog and digital I/O for PCs and controllers. JED also makes a PC PROM programmer and RS232/RS485 converters.

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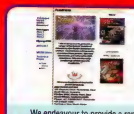

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Elexol offers SILICON CHIP readers 10% discount on I/O USB add-on boards

Last month we introduced SILICON CHIP readers to the new range of USB modules from Elexol.

The Elexol USBIO24 V3 is the second generation of a low-cost integrated module for the input and/or output of digital signals from a computer system by connection to the USB port. The USB port also supplies power to the module.

Elexol now also have a range of add-on boards for the I/O module, significantly extending an already very versatile system.

Included in the range are an opto-isolated input board, aconnector/LED board, a switch/push button board and a 50-pin IDC connector board.

All can be viewed on the Elexol website, www. elexol. com.au/IO_Modules, along with their specifications.

Even more importantly, if you order any of these boards via their online store and quote the code SIL1104, Elexol will give you 10% off for the month of November.

While you're on line, check out Elexol's other goodies!

Contact:
Elexol Pty Ltd
PO Box 5972, Bundall Qld 4217
Tel: (07) 5574 3988 **Fax:** (07) 5574 3833
Website: www.elexol.com.au

Here's how to add infrared remote control to all your PICAXE-08M projects!

PICAXE infrared remote control

By Clive Seager

IN THE SEPTEMBER 2004 issue, we showed you how to assemble "Rudolph the Red-Nosed Reindeer". Rudolph is a simple Christmas decoration with flashing LEDs that can play a variety of tunes, including mobile phone ring tones. As promised, this month we assemble the infrared remote transmitter and add the receiver components to Rudolph's PC board.

Before we describe how to assemble the various pieces, let's first take a look at the basics of infrared transmission on the new PICAXE-08M.

Infrared remote control

The PICAXE-08M includes two commands for sending and receiving data over an infrared link. The **infraout** command sends data on pin 7, whereas the **infrain2** command receives data on pin 3. Data is transferred using a simple modulation technique based on the well-documented Sony Infrared Remote Control System (SIRCS) protocol.

The SIRCS protocol uses a 38kHz modulated infrared signal consisting of a start bit (2.4ms) followed by 12 data bits (7 data bits and 5 device ID bits). Logic level "1" is transmitted as a 1.2 ms pulse, logic '0' as a 0.6ms pulse. Each bit is separated by a 0.6ms gap (see Fig.1).

When used within Sony production devices, the 5 device ID bits represent the type of equipment (1 = TV, 2 = video, 26 = DVD, etc). The 7 data bits represent different commands (1 = channel 2, 2 = channel 3, 16 = channel up, 20 = mute, etc). Within this PICAXE project the Sony-allocated commands are not relevant, but a full list is provided in the PICAXE manual for those interested in controlling their own Sony hardware!

START	COMMAND CODE							DEVICE CODE				
S	D0	D1	D2	D3	D4	D5	D6	C0	C1	C2	C3	C4
2.4ms	LOGIC '0' = 0.6ms, LOGIC '1' = 1.2ms											

Fig.1: basics of the SIRCS protocol, showing the composition of each serial transmission. A logic "1" is represented by a 1.2ms burst of the 38kHz carrier, whereas a logic "0" is represented by a shorter 0.6ms burst. Each bit is separated by a gap of 0.6ms.

Sending data

To transmit infrared data, the PICAXE command is:

infraout *device,data*

For example, to send the Sony command "TV - mute", the command would be **infraout** *1,20*. Note that *device* should always be 1 when used in PICAXE projects and *data* can only be between 0 and 127, as the SIRCS protocol only specifies 7-bit capability.

The full program for the transmitter is shown in Fig.6. As infrared signals are easily corrupted, the data is actually sent 10 times to increase reliability. This matches commercial remote controls that tend to transmit the data at 45ms intervals whilst the button is held down.

Note that the program uses codes "1", "2" and "3" for the three switches, but you can edit these to any number between 0 and 127. This would be useful when you want to control multiple units in the same room, using different *data* commands for each unit.

Building the transmitter

As hinted at in September, the various tunes played by Rudolph can be triggered remotely using an infrared transmitter. This simple project uses a PICAXE-08M micro, three push-button switches and an infrared LED to make a complete hand-held remote, the circuit for which appears in Fig.2. A second visible LED is included for user feedback.

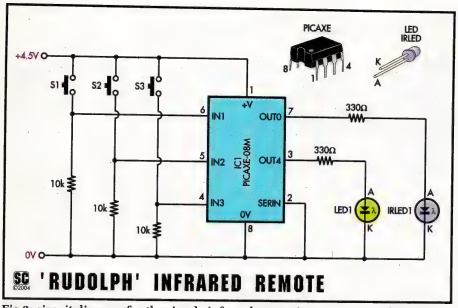

Fig.2: circuit diagram for the simple infrared transmitter. As no serial link socket is provided, the PICAXE chip must first be plugged into the "Rudolph" PC board (described in September 2004) for programming.

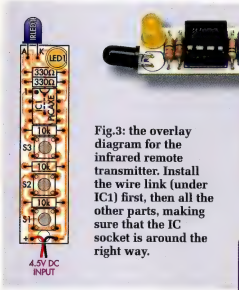

Fig.3: the overlay diagram for the infrared remote transmitter. Install the wire link (under IC1) first, then all the other parts, making sure that the IC socket is around the right way.

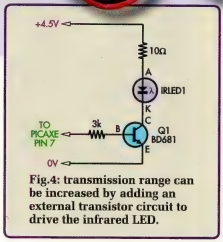

Fig.4: transmission range can be increased by adding an external transistor circuit to drive the infrared LED.

Assembly is very straightforward and should only take a few minutes. Begin by installing a wire link in the position indicated by a dotted line on the overlay diagram (Fig.3). An off-cut resistor leg is ideal for the job. Note that as an IC socket will be mounted over the link, it must be lying flat on the PC board before soldering.

Install all of the resistors, switches and IC socket next, making sure that you have the notched (pin 1) end of the socket around the right way.

Install the two LEDs next, noting that the infrared LED (IRLED1) leads must be bent at 90 degrees so that it points away from the PC board (see photo). Make sure that you have the flat (cathode) sides of the LEDs oriented correctly. The infrared LED may be supplied in either a "black" or "water clear" epoxy package.

Finally, solder the battery leads to the positions indicated after threading through the adjacent hole. Note that the board runs from a 4.5V (3 x AA) battery pack – do not connect a 9V PP3 battery!

To reduce overall size, a serial link socket is not provided on the transmitter PC board. Therefore, the PICAXE-08M chip must be programmed on the main Rudolph PC board and then transferred to the transmitter board.

After assembly and programming,

Parts List

1 infrared PC board
3 miniature pushbutton switches (S1 - S3)
1 battery clip
1 3 x AA battery holder
1 8-pin IC socket

Semiconductors
1 PICAXE-08M (IC1)
1 Vishay TSOP4838 infrared receiver IC
1 5mm yellow LED (LED)
1 5mm infrared LED (IRLED)

Capacitors
1 4.7µF 16V PC electrolytic

Resistors (0.25W 5%)
3 10kΩ
2 330Ω

Also required (not in the kit)
Rudolph kit (part no. AXE107S)
PICAXE Programming Editor software (v4.1.0 or later)
PICAXE download cable (part no. AXE026)
3 x AA alkaline cells

Obtaining kits & software

The design copyright for this project is owned by Revolution Education Ltd. Complete kits (Part No. AXE108S) and/or the Vishay infrared receiver (Part No. LED020) for this project are available from authorised PICAXE distributors – see **www.microzed.com.au** or phone Microzed on (02) 6772 2777.

The PICAXE Programming Editor software can be downloaded free of charge from **www.picaxe.co.uk** or ordered on CD (part no. BAS805).

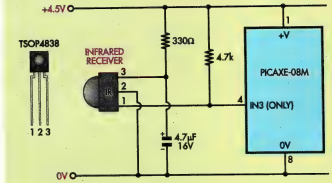

Fig.5: any PICAXE-08M can receive infrared remote control signals with the addition of just a few components, as shown here.

you can check transmitter operation by looking at the infrared LED "end-on" through a webcam or digital camera (such as a mobile phone camera). Although the LED is not visible to the naked eye, these camera are sensitive to infrared light and so the infrared LED will display a faint glow on the camera screen whilst operating.

Extending transmitter range

A 330Ω resistor is used in series with the infrared LED to limit current flow from the PICAXE port pin to an acceptable level. This gives a transmission range of about 4-5 metres, which should be enough for most users.

However, infrared LEDs can typically be driven with a much higher current, thus extending the potential transmission range. If you need the maximum possible range, then a transistor driver circuit can be added between the PICAXE infrared output pin and the LED, as shown in Fig.4.

Receiving data

The infrared receiver portion of the "Rudolph" circuit from last month is reproduced in Fig.5. Any PICAXE-08M project can receive infrared remote control signals with the additional of these four components.

A Vishay TSOP4838 infrared receiver IC demodulates the 38kHz carrier wave to give a logic output. It also contains filters to suppress noise signals from devices such as fluorescent lights. The block diagram of the receiver is shown in Fig.8.

To receive infrared data, the PICAXE command is simply: **infrain2**

This command waits for a valid input signal and then stores the data in a variable named "infra". This variable can then be used to play different tunes, as shown in the full receiver program in Fig.7.

As the PICAXE-08M uses the standard SIRCS protocol, the receiver will also work with commercial "universal" style infrared remote transmitters. These are widely sold as "one-for-all" replacements for use with home audio and video equipment. All you need to do is program them with one of the Sony-compatible equipment codes from the supplied list of manufacturers codes.

Rudolph upgrade

Only two parts remain to be added to the Rudolph PC board. The receiver IC is soldered into the "IR" position, with the leads bent over so that it lies flat on the board.

A 4.7µF capacitor is also added to filter the supply, noting that the positive lead goes in as indicated by the "+" marking on the overlay diagram. The 330Ω and 4.7kΩ resistors should already be installed on the board, as they were part of the original assembly.

Finally, reprogram Rudolph with the BASIC code listed in Fig.7, which adds the necessary infrared remote control functions. That done, you should be able to choose between three tunes using the buttons on your remote control board!

Summary

With a minimum of external components and the new **infraout** and **infrain2** commands, you can add remote control capability to all of your

Fig.6: Transmitter Program Listing

```
' Wait until switch press
main:
  if pin1 = 1 then tx_1
  if pin2 = 1 then tx_2
  if pin3 = 1 then tx_3
  goto main

tx_1:
  let b1 = 1                    'Code 1
  goto tx_ir

tx_2:
  let b1 = 2                    'Code 2
  goto tx_ir

tx_3:
  let b1 = 3                    'Code 3
  goto tx_ir

' Transmit code 10 times for increased reliability
tx_ir:
  high 4                        'visual LED on for user feedback
  for b2 = 1 to 10              'send infrared code 10 times
  infraout 1,b1
  pause 45
  next b2
  low 4                         'LED off
  goto main
```

Legs Versus Pins

In PICAXE BASIC, "pin" refers to a logical input or output port number, not a physical pin. Conversley, physical pins are referred to in the PICAXE documentation as "legs". Confused? We're not surprised.

When describing a PICAXE circuit, Silicon Chip will continue to refer to physical pins as "pins", just as we do for all our projects. We'll leave the legs for the organic world! (Editor.)

Fig.7: Receiver Program Listing

```
' ***** main loop *****
main:
  infrain2                    'wait until infrared signal
  'debug infra                'optional display on screen for testing

' ***** play tune *****
'play tune depending on light level
  if infra = 3 then play_xmas
  if infra = 2 then play_rudolf
  if infra = 1 then play_jingle
  goto main

play_jingle:                  'internal tune Jingle Bells

  play 1,3
  goto main

play_silent:                  'internal tune Silent Night
  play 2,3
  goto main

play_rudolf:                  'internal tune Rudolf The Red Nosed
                              'Reindeer
  play 3,3
  goto main

play_xmas:                    'external ring tone tune

'We Wish You a Merry Xmas
tune 3, 4,($22,$27,$67,$69,$67,$66,$24,$24,$24,$29,$69,$6B,$69,$67,
$26,$22,$22,$2B,$6B,$40,$6B,$69,$27,$24,$22,$24,$29,$26,$E7,$22,
$27,$67,$69,$67,$66,$24,$24,$24,$29,$69,$6B,$69,$67,$26,$22,$22,
$2B,$6B,$40,$6B,$69,$27,$24,$22,$24,$29,$26,$A7,$22,$27,$27,$27,
$E6,$26,$27,$26,$24,$E2,$29,$2B,$69,$69,$67,$67,$02,$22,$22,$24,
$29,$26,$E7)

goto main
```

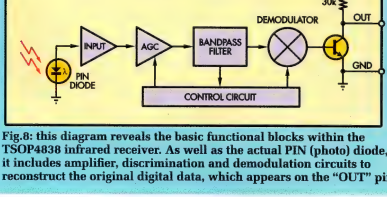

Fig.8: this diagram reveals the basic functional blocks within the TSOP4838 infrared receiver. As well as the actual PIN (photo) diode, it includes amplifier, discrimination and demodulation circuits to reconstruct the original digital data, which appears on the "OUT" pin.

PICAXE-08M projects. "Rudolph the Red-Nosed Reindeer" demonstrates how it all works, and might even be a party favourite come Christmas! SC

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Is this one of Stan's wind-ups?

Emergency power, when all else fails...

by Stan Swan

Back in the 20th century, it used to be said that you *really* knew you were a parent when battery costs for your kid's toys exceeded monthly power bills.

Fortunately, recent spectacular improvements in rechargeable technology now offer cost-effective secondary batteries and chargers – and at keen prices.

NiMH "AA" cell energy capacities have near tripled from 750mAh to well over 2000mAh since the year 2000.

It's assumed you'll have a nearby mains outlet for recharging – but many occasions arise (commuting in a peak-hour train maybe) when you're away from such facilities but with hi tech toys crying for a top up.

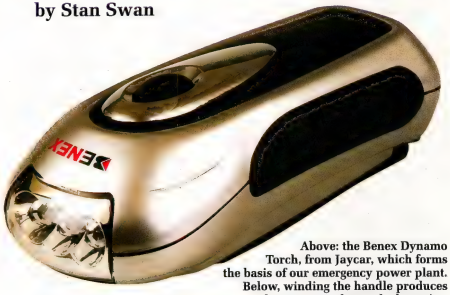
Such an occasion arose recently, when bad weather meant a mate on a weekend walkabout, hunting in a nearby but isolated NZ mountain region became hut-bound for nearly a week – trapped by a flooded river.

Although warm and dry indoors, the batteries in his mobile phone, radio and torch all progressively ran flat. Even his digital camera, intended for the 12-pointer deer he'd hoped to shoot, gave up!

Perhaps a solar panel would have helped, although the scudding winter rain clouds, which caused the flood in the first place, rather hinted otherwise.

In despair at his "Joule less" plight, he even took to the old trick of warming batteries in the oven and chewing their outer casings to persuade a few more electrons to flow...

At least he had an ultra bright white LED torch! Let's face it – these efficient lighting devices have been one of *the* most benevolent developments in dec-



Above: the Benex Dynamo Torch, from Jaycar, which forms the basis of our emergency power plant. Below, winding the handle produces the power to charge the batteries.

The opened-up torch, showing where we "tapped in" to the rectified dynamo supply (blue arrows). It's not difficult to do and the full functions of the torch are retained.

ades. But even they typically only offer 80 hours on "lite" mode – perhaps a week of evening use if half charged.

Yes, all very inconvenient – but fortunately just as Search and Rescue were being briefed the lost hunter reappeared.

Improvise . . . or starve!

Back at civilisation, the challenge was put to me: "Fix me up a reliable charger, or no venison next trip". A past SILICON CHIP article on modified disk drive generators sprang to mind but their output looked limited to LED lighting only.

Additionally, bush tramping demands near-bullet-proof devices, otherwise rain and mud may rule over fine engineering. Marine emergencies further throw their own brand of cruelty and inconvenience...

Short of carrying in a generator, PV panel and SLA gel cell, rigging a thermocouple to the fireplace or poking a wind turbine above the bush line, just what other ready approaches exist to generate a few crucial watts? Digital smoke signals?

I see the light!

Here's where I got lucky: a call to Jaycar Electronics revealed a Swiss-designed BENEX Dynamo LED torch – Cat ST3337 – amongst their superb lighting range, priced around $AU30.

Aside from the torch's normal multiple 15,000mCd lighting options, a sturdy handle folds out to hand charge the unit's internal 3.6V Li-Ion battery. Claims that "1 minute wind-up = 30 minutes lighting" imply a 30:1 charge/discharge ratio, so that a 20-30mA drain LED may indicate a dynamo output of a good half amp.

Impressive, although perhaps rather optimistic unless the LEDs are pulsed and actually draw less current!

Disassembly of the torch revealed a sturdy brushed geared electric motor, measured as providing about 9V DC at some 200-300mA to a simple 12V lamp dummy load. While not 0.5A, this output (say 6V @ 0.25A) hence satisfies the magical 1W energy budget our emergency quest demands.

A 4-diode rectifier bridge on the lamp's PC board ensures unidirectional generator output (along with two 0.6V voltage drops), and soldering across two diodes readily allows external connections to be made.

For even more efficiency you could replace the four diodes with suitably rated Schottky diodes, with their much lower (~0.1V) forward voltage drop. However, these devices are fairly expensive.

Of course any neat output socket could be used but simple red and black banana types were found most versatile – space inside the torch just allows for these – and likely to be the most useful with cold hands or broken connectors.

The torch's existing lighting circuitry remains quite unchanged, so naturally it still operates as a very bright and ergonomic LED torch.

Performance?

Many mobile phones and UHF transceivers now idle at just a few milliamps on squelched receive, so almost a 50:1 energy benefit could result.

Typically, a minute's winding (about all you'd get away with on a peak-hour train before dirty looks develop!) should extend reception by about half an hour.

Outgoing transmissions will be power hogs, so text messages may be the best energy investment (although a "minutes winding for a minutes talk" may be tolerable in an emergency).

As a bonus the 5V or so delivered by this modified "1 Watt Wonder" can also charge up to four normal AA or AAA NiMH/NiCds.

You need to appreciate charging maths – dead flat cells, of say 1200mAh capacity, will need hours of unrealistic winding to bring to full charge.

But even five minutes may be enough to persuade your digital camera to snap that trophy shot, find your dropped car keys, phone your mates or – phew – call the rescue chopper. **SC**

We found a pair of banana sockets (polarised of course) with matching banana plugs gave the best result. There's room inside the torch for a variety of small sockets.

Vintage Radio

By RODNEY CHAMPNESS, VK3UG

Those troublesome capacitors, Pt.2

Some vintage radio receivers are far more tolerant of leaky capacitors than others. It all depends on the circuit configuration and the role of each individual capacitor.

LAST MONTH, WE LOOKED at the problems paper capacitors can cause in vintage radios, often because they have become electrically leaky. Paper capacitors are troublesome and require replacement more often than other components, although perhaps not as often as many people believe.

We also looked at the Healing R401E, a vintage radio receiver that can operate successfully with quite leaky capacitors. This month, we take a look at the Healing 505E, which isn't quite so forgiving.

The Healing 505E

As shown in Fig.2, this set is quite different to its older brother. We'll start by considering capacitors C5 and C12. These are screen bypasses and the leakage across C12 should not be less than 20 x R4 (ie, 20 x 100kΩ) which is equivalent to 2MΩ. If C12's resistance is much less than this, the voltage on the 6BA6's screen will be noticeably less than intended and the performance of the set will suffer.

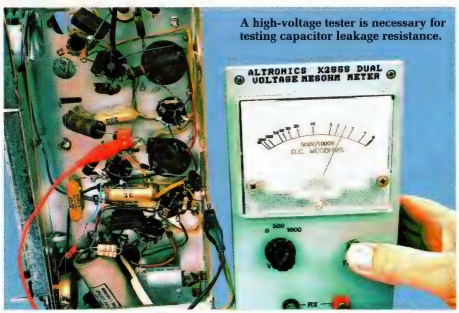
By contrast, C5's leakage can be somewhat greater (less resistance), as R2 is only 22kΩ.

C4 (the AGC bypass) is supplied with AGC voltage via R7 (1MΩ) and both the 6BE6 and 6BA6 valves receive back bias via a combination of R7 and R8. If C4 were to become leaky to any extent, the bias on the valves would be reduced. As a result, they would work harder and the set could become unstable and oscillate.

Basically, if C4 is leaky, the voltage across R7 increases. If the leakage is bad enough, little AGC bias will be applied to the two valves and this will cause distortion and other problems.

In fact, I have always considered the AGC bypass capacitor to be a very important. In this case, it should have a minimum leakage resistance of 20 x (1 + 1)MΩ, or 40MΩ (R7 and R8 are both 1MΩ resistors).

My practice is to replace the AGC capacitor without even testing it and I like it to have a leakage resistance of at least 100MΩ. In fact, I usually replace AGC bypasses with 50V disc ceramic capacitors. They are reliable and easily hidden under other components.



A high-voltage tester is necessary for testing capacitor leakage resistance.

An interesting fault

We now come to capacitor C15 which couples the audio from the detector to the first audio stage (6AV6). The maximum voltage across this capacitor will be no more than about 20V and yet it is rated at 600V! Note also that the grid resistor (R11) for the 6AV6 is a 10MΩ unit.

Why so high you might ask? The answer is that the valve itself develops contact potential bias and the desired bias is obtained by connecting a 10MΩ resistor from grid to earth/cathode. However, such a high resistance means that the leakage across C15 must be around 200MΩ or more, if the valve bias is not to be upset.

Note that most multimeters will be struggling to measure this amount of resistance. This is a very high impedance part of the receiver circuit.

OK, I've said that the voltage across this capacitor is no more than around 20V and that's with a very strong station tuned in. An interesting fault

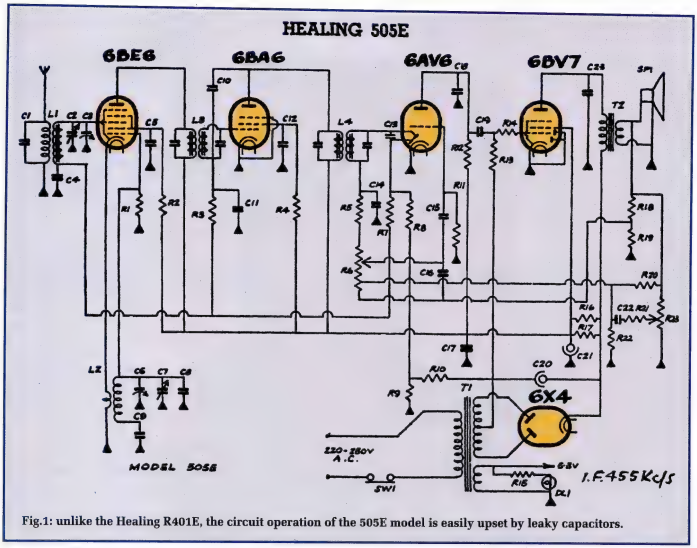


Fig.1: unlike the Healing R401E, the circuit operation of the 505E model is easily upset by leaky capacitors.

shows up when this capacitor is moderately leaky. With a relatively weak station, everything appears to be normal – the volume increases as the volume control is advanced. However, when a strong station is tuned in, the volume decreases as the volume control is advanced and it may even completely disappear as the control is rotated to maximum. Now that is an interesting fault!

Let's see how this occurs. As shown on Fig.1, the volume control (R6) wiper taps off a variable amount of audio and negative voltage relative to earth. This variable negative voltage is applied to the bottom end of C15, while the top end has around -1V on it relative to earth (ie, the contact potential bias).

Now let's assume that the voltage developed at the top of R6 (relative to earth) is -15V and that the wiper is at this position (ie, maximum volume). Further, let's say that the leakage resistance across C15 is R_L. In operation, RL and R11 will act as a voltage divider across R6. As a result, the voltage at the junction of C15 and R11 is $[R11/(R_L + R11)] \times -15V$.

OK, now let's assume that C15's leakage resistance (R_L) is 50MΩ. By plugging this figure into the above equation, we get $[10M\Omega/(50M\Omega + 10M\Omega)] \times -15V = -2.5V$.

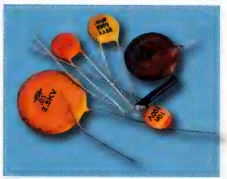
If this is added to the existing -1V contact potential bias, it means that the there could be as much as -3.5V of bias on the 6AV6. In practice, however, the voltage will be probably be somewhere between -2.5V and -3.5V. But even -2.5V is enough to cut off a 6AV6 in this circuit, resulting in no output on a strong signal at "full" volume!

In fact, even 100MΩ of leakage resistance in C15 will dramatically alter the operating conditions of the 6AV6.

Second audio coupler

Capacitor C19 – the audio coupler between the plate of the 6AV6 and the grid of the following 6BV7 – also needs to have quite low leakage (ie, high resistance). This is necessary for the 6BV7 to work correctly.

Resistor R13 is 470kΩ, so by my normal rule of thumb, C19 must not



Disc ceramic capacitors are ideal for use as AGC bypasses. They are reliable, have very low leakage and easily hidden under other components.

Photo Gallery: General Electric Duette

Manufactured in 1934 by AWA, the "Duette" was a 5-valve reflexed superhet receiver that was electrically equivalent to the AWA Radiolette Model 27. The valve line-up was as follows: 78 RF amplifier, 6A7 frequency changer, 6B7 reflexed IF/audio amplifier/detector/AVC rectifier, 42 audio output and 80 rectifier. Photo: Historical Radio Society of Australia, Inc.

have less than 20 times this resistance to be satisfactory – ie, about 10MΩ. However, in this case, the rule breaks down.

Let's find out why. First, the plate of the 6AV6 is at about +70V and, assuming that C19 has a leakage resistance of 10MΩ, this means that +3.3V will be developed across R13 (this is calculated using the same formula listed above). This means that with -4.5V of bias on the 6BV7's grid and +3.3V R13, the 6BV7 will have around -1.2V of bias.

In reality, it will actually be higher than this, as the valve will draw excessive current through the back bias network. As a result, both the power supply and the 6BV7 will be considerably overloaded and expensive fireworks could easily occur.

So my rule of thumb of allowing a resistance of 20 times the value of any resistor associated with the capacitor is seriously in error in this case - just as it was with the coupling capacitor to the first audio grid. Even if the leakage resistance were 200 times the value of R13, the voltage developed across R13 would still be +0.33V, which is enough to slightly upset a high-gain short grid base valve such as the 6BV7.

As a result, in this location, I expect to see at least 100MΩ of leakage resistance. You can now see why I am rather paranoid about the condition of the audio coupling capacitors.

Other critical capacitors

C18, a 400V mica capacitor, is intended to filter out most of the remaining 455kHz energy in the audio amplifier. Mica capacitors are usually quite reliable but when they do play up, they can be difficult to fault-find.

In this position, the usual effect is a "crackle" in the sound. Tested with a normal multimeter, it may show no leakage resistance and its capacitance may be at the marked value. However, a high-voltage tester will often detect abnormal and varying leakage resistance across the capacitor.

C23 from the plate of the 6BV7 to earth has the normal HT voltage applied across it plus the peak audio voltage. This means that this capacitor needs to be rated much higher than the circuit's HT voltage and about double this voltage is the recommended figure. As a result, a 600V paper capacitor is usually fitted here. If its leakage resistance is relatively low, this capacitor can get quite hot and can go short circuit.

C17 is the RF bypass across the HT line and has the full HT DC voltage applied across it at all times. Theoretically, it can be very leaky and still function OK. However, if a capacitor is too leaky, it will behave as though there is also a resistor inside its case. As a result, it will heat up and this can have a cumulative effect – as it gets hotter, its resistance drops and so it gets even hotter.

This can easily develop into a runaway scenario and the capacitor needs to be replaced "pronto".

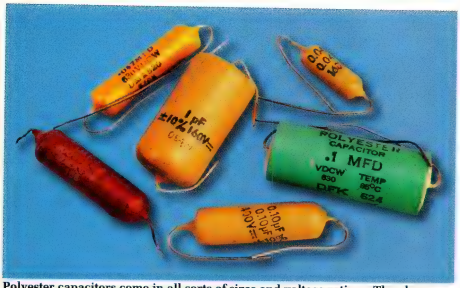
A word of caution is needed here. Before checking whether a capacitor has become warm to the touch, do the following things for your safety:

(1.) Turn the set off and remove the power plug from the power point (if the set is left connected to the power point, 240VAC could still be lurking in the receiver waiting for an unwary finger to touch it!);

(2.) Make sure that the high-tension (HT) voltage has disappeared (check the HT line with your multimeter).

Only then can you can put your "pinkie" on the insulated case of the capacitor to check whether it has become warm or not. A time-honoured technique is worthy of mention here – when probing around the inside of a set, keep one hand in your pocket. This is particularly important when using a test instrument on a live receiver.

Finally, C22 in the tone control circuit can be quite leaky and will



Polyester capacitors come in all sorts of sizes and voltage ratings. They have low leakage (although not as good as polystyrene types), are generally very reliable and can be easily hidden inside the cases of defunct paper capacitors.

have little effect on the operation of the control.

In summary, unlike the older R401E model, the Healing 505E generally cannot tolerate leaky paper capacitors. The audio coupling capacitors in particular are critical and these and a number of others need to be carefully tested. In some cases, it even pays to replace them as a matter of course.

Replacement capacitors

A 1nF (.001µF) capacitor must have a lot less leakage current through it than, say, a 270nF (0.27µF) capacitor. My rule of thumb is that no paper capacitor should have less than 2MΩ leakage resistance, while a 1nF capacitor should have at least 10-20MΩ minimum leakage resistance (as should other similar low-value capacitors). However, it does depend on just where it's going to be used in the circuit.

Some brands of capacitors were more prone to leakage than others. Ducon capacitors in the 1940s, 1950s and early 1960s were notorious for becoming leaky. UCCs were also sometimes leaky but more commonly became intermittent.

By contrast, the older Chanex capacitors seem to be more reliable and some of the "moulded mud" AWAs were OK as well, although many split their cases.

So what caused some brands of capacitors from certain periods to have a bad reputation? Frankly, I don't know, although I do have some thoughts on the matter. Perhaps someone who was employed in that part of the industry could enlighten me.

The Philips polyester capacitors that came onto the market in the early 1960s were a quantum leap forward as a replacement for the paper capacitors. Their reliability and low leakage is well known, although I had a polyester unit unexpectedly blow up just recently. There was smoke everywhere from it and the resistor that also burnt out when it failed (it went off like bunger).

However, that's just something that happens sometimes and polyester capacitors really are very reliable. There is no doubt that valve radios would have carried on for much longer if they had been available much earlier (ie, when the radios were manufactured).

Testing capacitors

There are two test procedures that will usually sort good paper capacitors from the bad ones. A check of the resistance between the two terminals of the capacitor is one such test. However, a normal multimeter will not give a reliable indication of the leakage resistance, as the applied voltage will be no higher than around 9V. Instead, it must be done using a high-voltage tester.

Altronics have such a high-voltage tester as a kit (Cat. K-2555) and the price is quite reasonable. It can test capacitors for leakage at either 500V or 1000V and is invaluable for testing nearly all capacitors other than electrolytics.

A high-voltage test will usually show up any capacitor with a leakage resistance of 200MΩ or less. 200V capacitors can be tested on the 500V range, as they usually have a peak rating well in excess of their normal operating voltage. Similarly, 400V units can be tested at 500V, while 600V (or 630V) capacitors can tested at 1000V.

Heat also has quite an effect on the leakage resistance of a capacitor. Some

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A selection of mica capacitors. Mica capacitors are usually quite reliable but when they do play up, they can be difficult to fault-find.

time ago, I salvaged all the paper capacitors from an old valve b&w TV set. To test them, I first heated them in an oven to about 70°C then checked them using a conventional ohmmeter.

Did I get a shock – they had all tested OK when cold but it was an entirely different story after they came out of the oven. I ended up throwing the lot in the bin. By contrast, the polyester capacitors I had salvaged from the same set were quite OK.

Checking in-situ

Checking capacitors in-situ (eg, in an old radio) involves first lifting one end of each capacitor in turn before checking it with the high-voltage tester. They can also be heated with a hair-drier so that they are warm (but not hot) and the checks repeated. You will soon discover whether a capacitor is worth leaving in the set or not.

A selection of polystyrene capacitors made by Ducon. Polystyrene capacitors have extremely low leakage.

A larger-value capacitor acting as (say) an HT RF bypass can be left in the set after passing a leakage test. It can then be reconnected, after which the set can be switched on and the HT voltage checked. If the HT is OK, wait a few minutes, then switch the set off and disconnect it from the mains. Finally, check that the HT rail has disappeared (use a multimeter) before checking the HT bypasses and electrolytic capacitors to see if any are warm. If they are, it signals that the units are too leaky and need replacing.

Why the high voltage?

As mentioned earlier, the Healing 505E uses several high-voltage paper capacitors in relatively low-voltage sections of the circuit. The reason for this is that the high-voltage units had better insulation and therefore less leakage (ie, higher resistance) than low-voltage types. As a result, high-voltage capacitors were used where low leakage was critical to the set's performance.

By the way, I have also found that paper capacitors have less leakage when only a low voltage is applied across them. As the voltage across them increases, so does their leakage.

"Earthy" end

Paper capacitors often had a (black) band at one end of the capacitor. This indicated the end that should go to earth when the capacitor was used as a bypass – or alternatively, the end that should connect to the lower impedance part of the circuit.

Why was that? Well, the band indicated the pigtail lead that was connected to the capacitor's outer foil. This outer foil (when earthed) acts as a shield, thereby reducing RF radiation when the capacitor is used as a bypass or filter.

Summary

(1.) The leakage resistance of a paper capacitor depends on the voltage across it, its voltage rating, its capacitance and its temperature.

(2.) The circuit position dictates how leaky a paper capacitor can be and still be considered satisfactory. Audio coupling capacitors and AGC bypasses, in particular can have very little leakage, with a leakage resistance of around 100MΩ or more being the minimum acceptable resistance. This is to ensure that there is little or no alteration to the operating conditions of the part of the circuit they connect to.

By contrast, bypass capacitors can be quite leaky (a cathode bypass can be down to several kilohms in some cases and still operate satisfactorily). However, I recommend a minimum resistance of around 2MΩ for these capacitors.

(3.) A capacitor's leakage resistance will reduce (ie, the current through it will increase) when used in a set due to internal heating, particularly if the capacitor is relatively leaky. I consider a leakage resistance of at least 1-2MΩ to be the minimum for a large paper capacitor but this should considerably higher for low-value capacitors.

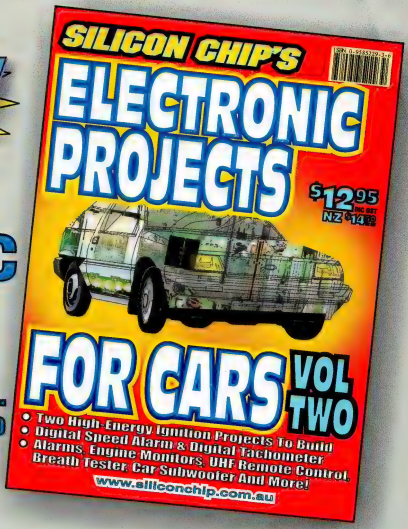
(4.) The circuit design will dictate how leaky the paper capacitor can be in certain location for the receiver to operate normally. Note the comparison between the Healing 505E and the Healing R401E described last month.

(5.) To ensure authenticity, keep at least some non-critical paper capacitors in a set. A good trick is to remove the internals of paper capacitors and fit polyester capacitors (which are physically smaller) inside the cases of the old capacitors.

That's it on the subject of paper capacitors. We'll cover electrolytic, mica and other lesser-known capacitors in a future article a little further down the track. **SC**

SILICON CHIP'S

Electronic Projects For Cars Vol. Two



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February 2003: PortaPal PA System, Pt.1; SC480 50W RMS Amplifier Module, Pt.2; Windows-Based EPROM Programmer, Pt.3; Using Linux To Share An Optus Cable Modem, Pt.4; Fun With The PICAXE, Pt.1.

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USB interface for PICs

I would like to know a good starting point for interfacing a PIC-based project to a USB port? I understand how to do the serial port with a PIC as there are only a few lines and the protocol isn't too tricky. Is there some snazzy chip that will do most of the protocol with a little bit of set-up from the PIC? (M. S., via email).

● If all you need is a high-speed USB serial connection, the FT245BM and FT232BM devices from FTDI are the way to go. Check out their web site at **www.ftdichip.com** for more information.

To make life even easier, these chips are available mounted on small plug-in modules that include all the necessary support logic, including the USB socket. You'll find examples at **www.elexol.com.au/USB_Modules** and **www.dontronics.com**, who also stock the FDTI chips.

If your needs are more specific, then Microchip offer the PIC16C745 & PIC16C765 with in-built USB ports. Alternatively, you could opt to interface your micro to one of many single-chip USB peripherals. A good place to start looking is **www.beyondlogic.org**

Headlight as WiFi reflector

I have a question regarding the article about "WiFry: Cooking Up 2.4 GHz Antennas" in the September 2004 issue. You say to use a parabolic shaped cooking scoop. Could a car headlight, with the glass removed do the same job? I'm pretty sure they are the correct shape and you could just replace the globe with the USB "dongle" and that would be it.

I'm not sure if the reflective material in the headlight is enough but I guess it could be lined with foil? (D. L., Rye, Vic).

● Provided the headlamp reflector is circular, it is a fair bet that it will be a paraboloid and therefore suitable for a WiFi antenna. The headlight metallisation should also work as a satisfactory reflector at 2.4GHz. On the other hand, most irregularly shaped headlight reflectors result in asymmetric light beams so they might not work as well with WiFi.

Transformer for 6-channel amplifier

I wish to build six 50W amplifier modules (SILICON CHIP, January & February 2003) for use in a home theatre system. These would be coupled with the 6-channel volume controller from the March & April 2002 issues. I am looking to build only one power supply for the six modules but the question arises, what capacity should my power transformer be? (W. N., Kurrajong, NSW).

● You need a single transformer with a rating of at least 300VA. Unfortunately, the closest readily available transformer is the Altronics M-5530 300V 30V-0-30V. This could be re-

RFID module: installation security concerns

I have recently purchased the RFID module (SILICON CHIP, June 2003) and have successfully assembled and tested it. This is an excellent device, with many possible uses and was easy to construct and use.

However, there are areas where it may be improved. First, the Reader Module could be closer to the outer panel (of whatever container is used) to maximise the operational range. At present, this is limited by the height of the output connectors.

Second, in the case of an external installation, the security of the door strike function is considerably reduced by the exposure of the connector terminals. It would be a simple matter for anyone who is "tech savvy" and attempting entry to jumper terminals until the strike was activated. The fact that an alarm is triggered (if present) may not deter a serious attempt.

The time allocated for door opening is about five seconds, which seems too short. It could be doubled to about 10 seconds without decreasing security very much.

In my situation I only need the door strike function, but the unit needs to be installed externally. I intend removing the connectors and hard-wiring the outputs to in-line insulated bullet connectors, which will connect to the external cabling behind the PC board.

The Reader Module will be placed as close as possible to the outer panel by lowering the higher components. The initialising can be done pre-installation (on the bench). (K. M., via email).

● We can't see how security of the door strike is reduced by the exposure of the connector terminals. Even if the module was completely encapsulated, the wiring would still be open to tampering.

The door strike "on" time is indeed set to five seconds. If you are knowledgeable about AVR microcontrollers and have access to a programmer, you can increase this time by altering the relevant parameter in the source code (RFID.ASM) and reassembling it.

Look under the heading "CONSTANTS". There you'll find a line that reads:

.equ LOCK_ON_TIME =10

The maximum possible "on" time is 16 seconds – ie, change 10 to 32.

duced by using a 12V 2A transformer (Altronics M-256L) in auto-transformer reduce mode, to reduce the input voltage to the 300VA transformer. The method is explained in this month's Circuit Notebook item on page 86. Alternatively, you could get one custom wound to 28V-0-28V from Harbuch Electronics, Phone (02) 9476 5854.

Reconnecting an LCD to a PC board

I have a talking clock radio that I rather like. Unfortunately, when I recently dismantled it to clean the switch contacts, the LCD detached itself from the circuit board and the attaching rubber strip of micro-conductors. This has caused me great distress considering how I will repair the connection.

Is my only solution to get out the microscope and some conductive epoxy glue and try to repair it? Or am I able to purchase a replacement LCD mounted on a board that I can solder? (D. V., Newcastle, NSW).

● You should be able to sandwich the elastomeric strip back between the PC board and the LCD and it should all go again.

Controller for 10-channel remote

I have brought and made up a 10-channel IR remote receiver kit from the February 2002 issue. I called Jaycar to get a kit to build a controller for it but they said they don't have one. I would like to know if there is such a kit or the wiring diagram, etc. (G. M., Moura, Qld).

● There is no kit for the controller. As outlined in the article, the circuit is designed to work with just about any pre-programmed remote that can control a satellite receiver. Have another look at the article.

Class-H amplifiers switch supply rails

It has come to my attention that some audio push/pull amplifiers have an extra switching transistor next to the main output transistors. Now having built a few amplifiers and studied electronics, I simply do not know what this extra transistor does. After looking at the old ETI-480 100W amplifier and a couple of other different amplifier modules, I cannot see how a switching transistor could possibly be used. Is it a different way of biasing the output transistors?

● You are probably referring to Class-H amplifiers (originally developed by Hitachi) which switch the output stages to higher supply rails to enable much higher short-term power.

Have a look at the Mighty Midget power amplifier in the March 2002 issue. This used class-H.

Courtesy light delay for cars

I have built and tested the Courtesy Light Delay kit as described in the June 2004 edition of SILICON CHIP. I have installed it into my 1989 Mitsubishi Magna Station Sedan (12V, negative earth). This model is fitted with a small light on the dashboard to show when the doors have not been properly closed.

The kit passes all tests when the motor is off; ie, the interior lights switch off after a delay of about 35 seconds or when the car lights are activated. My problem is that after the delay period upon entering the car, the interior lights then come on and dim to a lesser degree continuously while the motor is running and I am driving. Switching on the parking lights of course solves the problem. When the car is parked and the motor is off, all is OK.

I have disconnected the tail-light connections to the kit but the problem is still there. By disconnecting all four wires to the kit the interior lights work perfectly, as was always the case.

This has me confused and I would greatly appreciate any help you can offer. (R. C., via email).

● The circuit should not be triggered while the door switches are open. Capacitor C1 needs to be discharged fully via a closed door switch before the circuit can be triggered when the switch opens.

To solve your problem, you could connect the "to tail lights" terminals to the ignition supply. In this way, the courtesy lights would be held off via the optocoupler pulling the gate of Q1 to the source terminal.

Switching whine from speed controller

I am using a 12V Motor Speed Control, as described in the June 1997 issue of SILICON CHIP, on a vehicle windscreen wiper motor. I get a high pitched noise from the motor (and others) when power is supplied through the control unit. This does not occur if 12V power is supplied direct to the motor. Any ideas on what is causing the noise and how to get rid of it? (G. O., via email).

● All switch-mode speed controls cause motor whine. If your car has electric windows, you will probably hear some whine just as the motors

Extending a video monitor connection

I wish to locate my computer screen an increased distance from the computer chassis. The required cable length is of the order of seven to eight metres.

Can the average video card drive the signals this far? If not, can multiplexers/repeaters be used for the faster signals; ie, the R, G and B lines. Also, what type of cable would be required and are there any other issues involved with the increased distance?

Alternatively, can the keyboard and mouse be extended by same distance? (E. R., Rye, Vic).

● We're not aware of the maximum cable length for such a connection but believe that it would vary considerably from manufacturer to manufacturer.

We'd suggest initially trying the hookup using one or two good quality monitor extension cables (available from most computer resellers). If the results are unsatisfactory, then you have a couple of options.

You could purchase a purpose-built SVGA video extender, such as the "Belkin OmniView". These are available from various computer resellers in Australia.

For a do-it-yourself solution, check out the "Video & Pulse Distribution Amplifier" described in the December 1997 edition of "Electronics Australia".

Playmaster 300W amplifier hums & thumps

I'm hoping someone can shed some light on a couple of problems I have with a power amplifier for a 500W subwoofer. It's from the April 1995 issue of "Electronics Australia".

Ever since I built it six years ago, it has had a weird quirk: about one minute after switching power off, the attached speaker starts thumping. It starts off slowly (around two thumps per second) and loudly (about 10mm speaker excursion) and over the course of five minutes the thumping speeds up (maybe six thumps per second) and dies off. Somewhere in the middle, the thumping seems to switch to double-time.

The amplifier also has a "clipping" LED on the front panel, which is meant to show if you're driving the amplifier too hard. During its thumping routine, the LED flashes in time with the thumping.

Yes, I have checked for animals and small people trapped in the box!

The other quirk may be related – loud humming. Not when a source is plugged in but only when you touch the signal terminal of the input RCA lead with a finger. I don't know what frequency the hum is (no oscilloscope) but it sounds low, like a truck horn. It might be 50Hz but I don't really know what 50Hz sounds like.

The humming is quieter if you touch the shielding of the RCA lead with the same finger or if you touch the amplifier case with your other hand. Is this expected/normal? As I said, it only happens under these conditions. The amplifier operates noiselessly and as expected when plugged into my preamp and playing music. Thanks very much for any insight! (C. C., via email).

● The hum is probably due to instability in the Mosfet output stages; they're probably oscillating at 100MHz or more (you can check that with an FM radio). Check all the Mosfet gate capacitors.

The slow oscillation could be related to the above; ie, motorboating. Perhaps some of the bypass capacitors on the supply rails are open-circuit.

come to a stop. The noise is caused by the high-frequency switching signal which applies DC to the motor. You may be able to reduce the noise by altering the frequency a little. Try replacing the 10kΩ resistor at pin 6 of IC1 with a 20kΩ trimpot in series with a 4.7kΩ resistor. Then adjust the trimpot for the least noise from the motor.

Studio 350 fried resistors

I have built a Studio 350 amplifier module (SILICON CHIP, January & February 2004) and upon powering it up, I found that the voltage readings across the speaker terminals were nearly equal to the output voltage of the power supply. I have checked all the board parts and connections three times and can find no faults with the construction.

Later, as I was trying to adjust the voltages to zero as described, the resistors in the area of the audio input (Q2, Q3) fried, damaging the board surface somewhat. Can you suggest what to do next? (P. C., via email).

● Our guess is that you have swapped a pair of transistors or you have an open-circuit solder connection somewhere. Replace the fried resistors and power up the board again, with the resistors across the fuseholders, and check each transistor for a base-emitter voltage of about 0.7V. An incorrect reading indicates a fault in the transistor or its associated components.

Dr Video has dark rectangle

I have just finished building the Dr Video kit (SILICON CHIP, June 2004) and I have a dark rectangle block in the top lefthand corner of the screen. Any ideas? (S. J., via email).

● It sounds as if your vertical blanking pulse circuit (around IC6b, IC6c and IC5b) is generating a pulse longer than the correct 1.1ms. This is probably due to within-tolerance component variations, so we suggest you try replacing the 8.2nF capacitor with one of 6.8nF or 5.6nF. This should remove the "dark rectangle".

Volume control for valve preamp

I have a question regarding the Valve Preamp For Hifi (SILICON CHIP, February 2004). In the article you place the volume pot after the preamp. I was wondering if it could be placed before the preamp and would this change performance in any way? (R. D., Doncaster, Vic).

● There are arguments for and against putting the volume control in front of a preamp. Putting it in front means you reduce the chance of overload but it also means the signal to noise ratio of the final signal may not be as good.

Energy Meter can measure to 15A

Why did you limit your Energy Meter (SILICON CHIP, July & August 2004) to only 10A? I want to measure my air conditioner. How could I modify your design to go to (at least) 15A, please? (P. B, Turramurra, NSW).

● The Energy Meter was limited to 10A because this is the maximum rating of a general purpose mains outlet (GPO). You can still use the meter to measure 15A if your GPO, the fuse and power cords are rated for this. It would be wise to bypass the relay for 15A measurements, to prevent damaging the relay contacts. Otherwise, the meter can operate at 15A (3600W) without any software or hardware changes.

Micromitter's filter is faulty

The last time I was in Australia, I purchased an FM Micromitter kit (SILICON CHIP, December 2002) in Brisbane. I have now built the kit and have a problem – there is very little RF output.

I looked at the Rohm website and found an Application Circuit for the BH1417F chip employed in the kit. It shows a 1nF DC blocking capacitor between the chip output and the GFWB3 filter. The data indicates that there should be typically (Vcc - 1.9) volts on pin 11.

In my version there was no voltage on pin 11 because pin 1 of the filter has

DC continuity to ground. I have fitted a 1nF capacitor and the unit now works correctly, with about 3.1V on pin 11. However, I wondered afterwards if the filter input is actually pin 3, which does not have DC continuity to ground and perhaps I could have just reversed the filter on the board.

Have you encountered this problem before. (D. D., Cheltenham Spa, UK).

● There should be no need to have a DC blocking capacitor before the filter as the filter is capacitive. Perhaps your filter has a fault, causing DC to flow to ground.

No secret code for LED marking

Like many readers I have been experimenting with a variety of LEDs. Given the state of my workbench, I now have quite a random collection – all unmarked!

Is there any way of finding out LED characteristics from scratch? And is there any logical reason why manufacturers refuse to mark LEDs with type numbers (or have I missed some secret inscription)? After all, if transistors were unmarked where would we be? (J. B., Dalton, NSW

● Short of testing all your LEDs with a low-voltage DC source, there is no way of knowing their characteristics. And if you can find the "secret way" of LED marking, please let us know and we will pass it on to the world at large!

240V halogens still have UV output

I know you never were too keen on 12V down-lighting with inefficient hot transformers but have you seen the new 240V halogens that K-mart and other chains now sell? They are glass encased, so no UV radiation and are rated at 50W.

I am wondering if these kinds of halogens are OK to use with normal light dimmers. Mine dim OK but I am worried if I am reducing the life of the halogens that may need to run hot like other halogens.

● 240V halogens have been available for some time but we are not aware that the types you refer to have zero ultra-violet output. Given the very high filament temperatures, that seems highly unlikely. In any case, using a dimmer with any halogen has the effect of reducing their efficiency as well as reducing life. Also 240V halogens tend not to last as long as 12V types because their much higher resistance filament is nowhere near as rugged.

Fridge causes TV interference

I have a new GE fridge which creates TV interference. There are waves across the screen which vary depending on the fridge motor speed. How can this be fixed? (B. C., via email).

● First, you must determine the mechanism of the interference. Is the interference visible on all channels? If so, it is possible that the motor's magnetic field is directly affecting the picture tube. Is the fridge close to the TV? If so, the cure is to move the TV away from the fridge.

On the other hand, if the interference is present only on one channel then the source is possibly some electronic circuit within the fridge. If so, it may well be a fault since consumer equipment is supposed to meet EMC standards. We would then make a complaint to the distributor, or in the first instance, to the retailer. **SC**

Notes & Errata

Programmable Robot, September 2004: there is an error in the circuit diagram of Fig.1 on page 65, concerning the programming cable socket (CON1). Earth should go to the tip of the 3.5mm socket, while the junction of the 22kΩ & 10kΩ resistors goes to the ring. The sleeve connection is correct, as is the PC board layout on page 66.

Garage Door Controller, October 2004: some readers want to use smaller motors with this kit and Oatley Electronics has advised that if R22 and R17 are changed to 82kΩ, the current is adjustable from 0-4A. Initially, set trimpots VR1 and VR2 to their centre positions, as the circuit may prematurely trip at the most sensitive settings.

Video Formats: Why Bother?, August 2004: a number of readers have asked where the PAL DVD test disc mentioned in the article can be obtained. Sanity currently stock the disc, on the web at **www.sanity.com.au** or phone 1300 722 121. Ask for the "Digital Video Essentials" DVD.

Universal Power Supply Board, August 1988: the 1000µF capacitor in Fig.8 (parts layout) is shown with reversed polarity.

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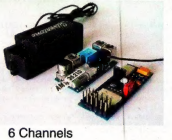

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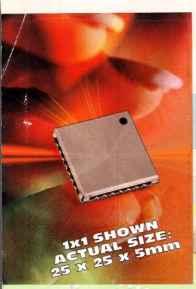

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